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MAMMALS OF WOOD BUFFALO PARK, NORTHERN ALBERTA AND DISTRICT OF MACKENZIE

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In 1931 the Dominion Government decided to undertake a comprehensive faunal survey of Wood Buffalo Park. This area lies 24 miles south of Great Slave Lake, Northwest Territories, and 110 miles north of McMurray, Alberta. Owing to the comparatively recent organization of the park, as well as its great size, such a task had not hitherto been attempted. The writer was assigned to the project for the two-year period from early June, 1932, to late May, 1934, with a base established at park headquarters, on Slave River, 25 miles south of Fitzgerald.

Investigations were carried out over wide areas at all seasons of the year. Most travelling was done by means of power boats and canoes, pack and saddle horses, and dog teams; a reconnaissance was also made by airplane. Special emphasis was placed upon a study of the northern bison, but general wildlife inquiries were also pursued at all times as vigorously as circumstances permitted. As a result of the survey, 46 species and subspecies of mammals, and 217 of birds, were recorded—all that are known at present to occur in the park and the immediate vicinity. The field notes are supported by a collection of 1,008 zoological specimens that were presented to the National Museum of Canada at the end of the expedition.

Wood Buffalo Park was set aside under the Forest Reserves and Parks Act in December, 1922. The territory is an unbroken wilderness of pristine character and much natural beauty. It is the largest big game preserve on the continent with a length of 176 miles, an average width of 100 miles, and an area of 17,300 square miles, or 11,072,000 acres. Approximately 13,675 square miles lie in northern Alberta and the remainder in the District of Mackenzie, Northwest Territories. Peace River intersects the southern part of the park to join the Slave-Riviere des Rochers drainage almost immediately north of Lake Athabaska. Slave, Salt, and Little Buffalo rivers form the eastern boundary

of the park to the mouth of the Nyarling. The latter river and the 34th base line (Lat. 60°31′ 30″ N) constitute the northern boundary.

Four distinct planes of elevation characterize the physical geography of the area. The highest is represented by Caribou and Birch mountains; the former is on the west with a height of about 3,400 feet above sea level and the latter on the southern boundary with an elevation of approximately 2,500 feet. East and north of them, respectively, is the Alberta Plateau, with an average elevation of about 1,000 feet. Most of the park is situated on this plain. Immediately to the east is the third natural division in the relief of the area, which may be known as the Salt Plains elevation; it varies in height from 600 to about 800 feet. The last topographic division consists of the alluvial lowlands along Little Buffalo, Slave, Peace, and Athabaska rivers, and about Claire, Mamawi, Baril, and Egg lakes. These lakes have a common level with Lake Athabaska of 699 feet (Soper, 1939).

Wood Buffalo Park is entirely embraced by the Canadian Zone and in respect to the Temperate Region occupies a high boreal plane. It lies some 270 miles southwest of the nearest Arctic tundra and 80 miles from the lower border of the Hudsonian Zone. The nearest approach of pure Transition Zone conditions is in about latitude 54°, or approximately 290 miles to the south. Faunal conditions are fairly uniform throughout the park. This relative biological uniformity, notwithstanding the long distance between the southern and northern ends of the area, is partly accounted for by a compensating decrease in altitude from south to north. It follows, however, that because of certain governing factors of dissemination, more species are found in the southern than in the northern park districts.

Flora of the area is of considerable diversity. Dense, or comparatively dense, forest covers the greater part. The principal trees are white and black spruce, Banksian pine, tamarack, white birch, and aspen and balsam poplar. The only deciduous trees are the last four species mentioned. As a zonal characteristic, coniferous trees predominate, imparting a decidedly boreal aspect to the country in general. In some sections, black spruce and tamarack swamps abound, together with open bogs and extensive muskegs grown to Labrador tea, sphagnum mosses, and other plant life. Elsewhere are inviting, well-wooded uplands interspersed with sandy ridges grown to pine. Prairie-like tracts occur on the eastern part of the Alberta Plateau, while high grass meadows are commonest on the lower Salt Plains and the alluvial lowlands to the east. Streams, lakes, ponds, and sink-holes are scattered throughout the region in great abundance.

The establishment of the park was primarily for the protection of about 1,500 wood bison which were known to inhabit the region. In addition to these magnificant animals, the territory abounds in moose, deer and bear, many species of fur-bearing animals, and other forms of wildlife. In fact, little fundamental change has occurred in the area since the first white man, Alexander Mackenzie, voyaged down Slave River on his way to the polar sea in the summer of 1789. The country holds many attractions for the mammalogist, especially on Alberta Plateau and Caribou Mountain. The latter is manifestly worthy of

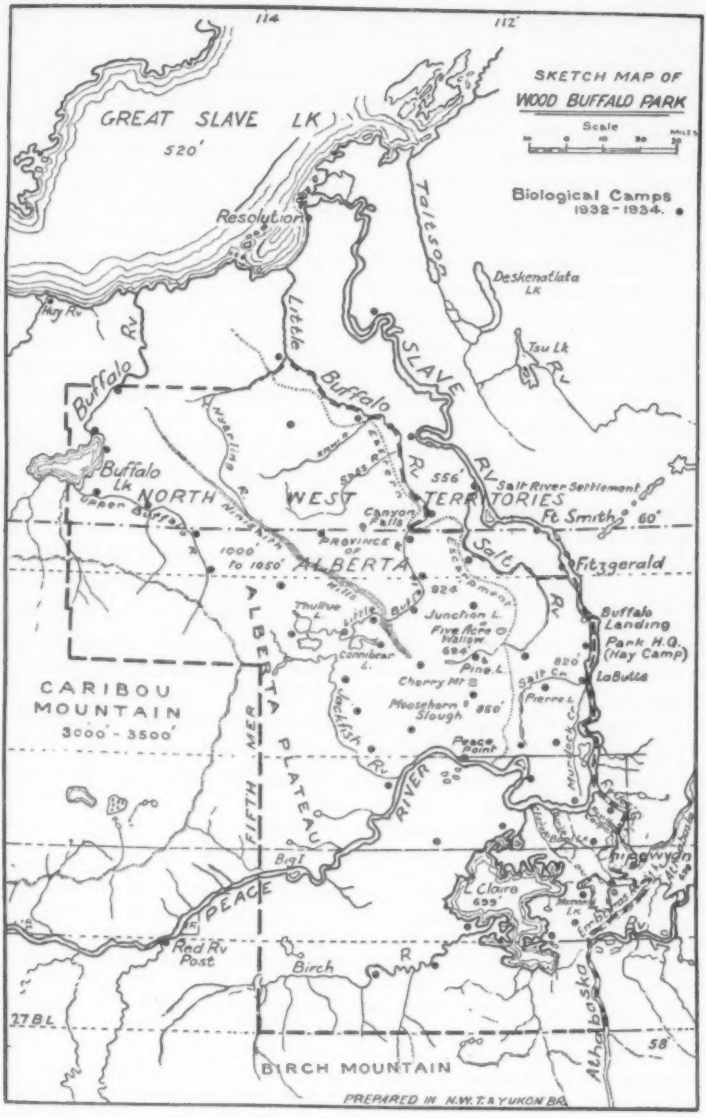
PLATE 1

UPPER: Open Banksian pine forest on the rolling uplands of Alberta Plateau, at Cherry Mountain, about 25 miles north-northeast of Peace Point, Peace River. September, 1933.
LOWER: Buffalo River at the northern boundary of Wood Buffalo Park, Northwest Territories. Typical Canadian Zone forest. July, 1932.

PLATE 2

Upper: An area of northern prairie in aspen poplar woods characteristic of the eastern portion of the Alberta Plateau and the Salt Plains elevation west of Slave River. March, 1933.

Lower: Scene along Salt River near the eastern boundary of the park, southwest of Fitzgerald, Alberta. Extensive grass plains exist in the immediate vicinity which constitute important winter forage areas of the northern bison. March, 1934.


114
112
SKETCH MAP OF
WOOD BUFFALO PARK
Scale
Biological Camps
1932 - 1934.
GREAT SLAVE LK
520'
Resolution
Taltson R.
Deskenatlata LK
Tsu Lk
Hay Rv
Buffalo Rv
Little Buffalo R.
SLAVE R.
Buffalo Lk
NORTH WEST TERRITORIES
Salt River Settlement
Ft Smith 60'
Canyon Falls
PROVINCE OF ALBERTA
1000' to 1050'
Salt R.
Fitzgerald
924
Junction L.
Buffalo Landing
Park H.Q. (Hay Camp)
Five Mile Willow
694'
Pine L.
820'
LaBuche
Cherry Mt
Moosehorn Slough
850'
Pierce L.
CARIBOU MOUNTAIN
3000' - 3500'
Peace Point
Murdock Cr.
FIFTH MER
ALBERTA PLATEAU
RIVER
Chinchaga R.
Brief
L. Claire
699'
PEACE
Red Rv Post
Birch R.
27 B.L.
BIRCH MOUNTAIN
Athabaska R.
58
PREPARED IN N.W.T. & YUKON BR.

attention, as it offers practically a virgin field of study for the smaller mammalia in particular.

Many observers have made valuable contributions to our knowledge of the mammals of the Athabaska-Mackenzie Basin. Most notable among them is Edward A. Preble who produced his celebrated North American Fauna No. 27 (1908) which has been the last court of appeal for wildlife information on the region north of Athabaska ever since its publication. Ernest T. Seton (1911) added valuable information as a result of his expedition through the region in 1907. Hitherto, however, except by inference, the greater part of Wood Buffalo Park was zoologically unknown. Extensive tracts continued unexplored and to a certain degree this still remains true. Very few naturalists have worked in this precise area and inquiries of this nature have usually been of short duration. So far as known, no zoologist had previously investigated the more remote interior; former activities were essentially confined to a few points of easy accessibility along Slave and Little Buffalo rivers, which now represent the eastern boundary of the park.

In sequence of species the present annotated list follows Miller's *Check-List of North American Recent Mammals*, 1923. Most of the vernacular names have been adopted from Anthony's *Field Book of North American Mammals*, 1928. I am indebted to Dr. R. M. Anderson, National Museum of Canada, Ottawa, who kindly determined all specimens of mammals collected in the park and brought the nomenclature up-to-date. All measurements are given in millimeters, in the order of total length, tail, and hind foot. Park Indians are often mentioned in succeeding pages. In explanation of this it may be said that when the area was set aside the Indians then resident there were permitted to retain their rights to hunt and trap, the only requirements being that they apply annually for a permit and that they observe the park regulations. The number of these permittees is about 400, or approximately one to each 43 square miles.

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ACCOUNTS OF SPECIES

Sorex cinereus cinereus Kerr. Masked Shrew.—This shrew is well distributed in the park. Trapping shows it to be especially fond of timbered areas along watercourses or about lakes in well-wooded uplands. Though partial to heavy, mixed forest, it is found in several different types of cover. Shrews of this species are active throughout the long northern winter as is evidenced by their fine, lace-like trails over the snow. In the bitterest cold of mid-winter they are occasionally found dead on open snowfields or in deep-trenched sled trails in the forest. Such specimens show not the slightest sign of injury, indicating death had resulted from exposure.

Specimens were taken at widely-separated points in the park, including Buffalo River, Lobstick Creek, Junction, Pine, Conibear and Mamawi lakes, Moosehorn Slough, Peace Point, Salt Creek, and Government Hay Camp. In the general vicinity of the latter, the species was more than ordinarily numerous. While generally distributed, it is apparently scarce in most areas. The average external measurements of a series of 14 specimens are 93.7, 37.2, 12 mm.; largest individual—112, 45, 14 mm.

Sorex arcticus arcticus Kerr. American Saddle-back Shrew.—This is apparently one of

the rarest small mammals of the region. Intensive collecting over extensive areas often failed to secure any specimens. The species was never taken in heavy forest, but was found in moist, grassy depressions about the borders of sloughs, and in rank vegetation of large meadows. At Junction Lake, a specimen was secured in wet, hummocky grassland, almost muskeg in character. Under nearly similar conditions three specimens were taken near park headquarters, Slave River, and another at Mamawi Lake. The comparative scarcity of *arcticus* is well demonstrated by the fact that only five specimens were collected in two years. These average 112.5, 42, 13.5 mm. Preble (1908, p. 245) took two specimens along Slave River below the mouth of the Peace and another at Fort Smith.

Sorex obscurus obscurus Merriam. Dusky Shrew.—This species was not detected in Wood Buffalo Park. The nearest point of recorded occurrence is one taken by Preble (1908, p. 244) at Mission Island, Fort Resolution, July 21, 1901. As this is only 35 miles from the northern boundary of the park, it may eventually be discovered within the northern area. Preble (*loc. cit.*) remarks, "The discovery of this species on Great Slave Lake and the upper Mackenzie is somewhat of a surprise, since no shrew of the *obscurus* type has hitherto been recorded from the interior of British America north of the Jasper House region in Western Alberta." The National Museum of Canada has one specimen taken by Dr. E. M. Kindle in the summer of 1919, at Simpson, mouth of Liard River.

Sorex palustris palustris Richardson. Richardson Water Shrew.—This species is one of the local rarities. Diligent search for it was made in likely places for more than a year before a single record was established. Finally, an adult female (150, 66, 19 mm) was captured on the shore of Pine Lake, September 7, 1933, under overhanging shrubbery of alder and willow. This area was flanked a few yards away by a dense spruce-poplar forest. Numerous sets were made in similar places during the two years, but no other example was secured. Preble (1908, p. 248) mentions a specimen from Fort Resolution, which measures: 150, 67, 19 mm. This, apparently, is the only other record for the region.

Microsorex hoyi intervectus Jackson. Northwestern Pigmy Shrew.—This diminutive shrew was not collected. Of the many small shrews taken, and skulls saved from individuals too badly eaten in the traps to preserve entire, all prove referable to *S. c. cinereus*. Preble (1908, p. 248), during the course of his collecting in the Athabaska-Mackenzie region, 1901-04, obtained more than a dozen shrews of this genus which he referred to *Microsorex eximius*. Up to this time it had not been recorded in the region. Some of these specimens were taken at Chipewyan, Fitzgerald, Fort Smith, and Fort Resolution. At Fort Smith he found them "occupying certain tracts almost to the exclusion of the common species [*cinereus*]." Five specimens from Fort Smith average 92, 30.4, 10.2 mm.

Myotis lucifugus subsp.? Little Brown Bat.—On June 4, and 7, 1932, about a dozen small bats were seen flying about the Pine Lake cabin, darkness on both occasions rendering capture impossible. Similarly small bats were also noted at park headquarters on June 19 and 20, but no specimens were obtained. In all probability they belonged to this species. A small bat observed by Preble (1908, p. 249) 10 miles below the mouth of Peace River, June 7, 1901, was thought to be *lucifugus*. In a letter dated October 14, 1933, Dr. R. M. Anderson mentions that he secured a specimen of this bat in the warden's cabin at Pine Lake in 1927, which, according to Dr. G. M. Allen, is *M. lucifugus*, approaching *alascensis*. Mention is made that "It is a little darker than the average little brown bat of the East, but some British Columbia specimens are fairly normal *M. l. lucifugus*." In August, 1933, an Indian hunter stated that he had several times seen small bats at Salt River Settlement and as far west as Little Buffalo River, which were probably of this species.

Eptesicus fuscus pallidus (Young). Pale Brown Bat.—On September 14, 1933, a single example of this species was taken from behind a corner board of the Pine Lake warden cabin. It attracted attention during mid-afternoon by repeatedly squeaking in a rather rasping, high-pitched tone, clearly audible for a distance of at least 25 yards. Long forceps served to extract it from its hiding place. This specimen, a female, measures 110, 43, 14; height of ear, 18; tragus, 9; extent of wings, 290 mm. Following identification of the above specimen, Dr. R. M. Anderson says in a letter of October 14, 1933, "We have specimens

[*pallidus*] from Lac la Nonne and other Alberta points, but no other records so far as I know from northern Alberta." Preble does not include the species in his 1908 list.

Lasiurus cinereus (Beauvois). Hoary Bat.—This bat was nowhere observed in the region from 1932 to 1934, and there is apparently no record extant for it in the park. The nearest is evidently Fort Resolution, Great Slave Lake, where Seton (1911, p. 358) observed one on July 12, 1907. He says, "This is apparently the northernmost record for the species in this region." Under the above circumstance it is obvious that Wood Buffalo Park comes within its known geographic range, and that the species is relatively rare in this region.

Ursus americanus americanus Pallas. Black Bear.—The black bear is one of the characteristic large mammals of the northern forests and ranges more or less commonly in favorable areas throughout the park. It is, however, much more numerous in some sections than in others. The animals are seldom seen in large muskeg and salt plain areas, but in poplar-spruce forest along rivers and over the rolling uplands of Alberta Plateau they may be comparatively common. On many occasions adults and cubs have been seen along Slave River, at times close to park headquarters. During many long summer journeys in the interior, numerous bears were found throughout the aspen-spruce-pine forest of the uplands in the heart of the park. The range is ideal about Pine Lake, south in a broad belt to and along Peace River, and northwards to and beyond Little Buffalo River. The animals were seen many times in this area (where claw marks on trees are common) and also west to Conibear Lake and along Little Buffalo River to the Ninishith Hills. In July, 1932, trails were noted all along Buffalo River from Great Slave to Buffalo Lake and, less commonly, along the upper Buffalo (Caribou) River to the forks south of the 60th parallel of latitude. Beaten trails in the woods and fresh and old spoors on the river margins were familiar daily observed features. As bears are timid, numbers actually observed are always low in comparison with existing sign.

An Indian hunter, William Clawhammer, with residence near the mouth of Nyarling River, informed us that bears were common in parts of the northern area—especially in spruce and in parkland type of aspen-pine forest about the Nyarling, Sass, Klewi, and Little Buffalo rivers and between the Little Buffalo and Slave rivers. Indians report the animals in numbers west of Salt River Settlement into the interior uplands, and south to and about the falls of the Little Buffalo River. A freshly-killed bear was seen at an Indian camp near the confluence of Klewi and Little Buffalo rivers. Occasionally well-depressed beds of bears, suggesting the animals had returned many times to sleep in the same place, are encountered in thickets. Near the Little Buffalo River Falls five such beds were noted in one aspen-willow thicket with an area no greater than 150 square yards. At several beaver ponds along this stream west of the Ninishith Hills bears were occupying quarters on the bank nearby and were feeding on suckers that had become trapped in the wicker-work of the dams.

Throughout the summer these animals exist as a potential menace to unguarded camps and far-flung cabins in the forest. At first this strikes one with surprise as they are habitually timid at other times. Not infrequently the service cabins are found with windows torn out by bears, whether these consist of ordinary glass, celloglass, or celluloid. In July, 1933, the Conibear Lake cabin was visited and it was discovered that a bear had forced his way through both windows—evidently entering by one and leaving by the other. Such pranks form the basis of many a tale told around the camp-fires of northern trails.

Procyon lotor subsp.? Raccoon.—Upon arriving in the park, June, 1932, Chief Warden M. Dempsey informed me that a raccoon had been captured by an Indian not far from Birch Mountain at Lake Claire. This event was of such extraordinary interest that Indians and whites alike speculated as to its probable origin and the route followed in entering the country. It was recalled that another had been trapped many years before. The species had never been seen previously in the region, a circumstance readily believed in view of the great distance of the district from the raccoon's normal range. Warden Dempsey reporting on the incident states: "Mr. J. Dewey Soper has expressed a desire to obtain full data in connection with a raccoon killed in the Annex during the fall of 1930. It was trapped on

the west side of Lake Claire in early December, 1930, by Francois Gibot (Permit No. 200) and sold to Mr. Fred Frazer, trader at Hay [Prairie] River in the Annex. Mr. Frazer reports that the raccoon was a large male and coarse haired. . . . It is said that about 1920 a raccoon had been trapped in the same locality, but the warden service is unable to get definite information concerning the one caught at that time."

Martes americana actuosa (Osgood). Alaska Marten.—Formerly the marten was plentiful over most of this territory, but of recent years it has become greatly reduced in numbers. This was strikingly noticeable during nearly 2000 miles of winter travel in 1932–33, when not more than half a dozen trails were personally observed. It is held by some that fluctuation is induced by migration; that numbers are controlled in the park area, for example, by a periodic exodus from Caribou Mountain, or that the movement is of a much wider scope. Whether migration, disease, over-trapping, or a combination of these is responsible, it remains that a pronounced local rise and fall in numbers is evident. In this respect the species undergoes a periodic cycle of abundance after the fashion of lynx, varying hare,etc., but ordinarily without similar intensity. MacFarlane (1905, p. 710) was inclined to believe that available data add strength to the migration theory.

A Peace River trapper stated in October, 1932, that the marten a few years before was very plentiful in the vicinity of Jackfish River and west to the Fifth Meridian, but that now it had reached a state of practical extermination. This he attributed in considerable measure to over-trapping. Warden Dempsey stated that in 1928, marten were common in the district about and north of Point Providence, Peace River. From personal observation, and from reports, it is evident that from 1932 to 1934, the marten was wholly absent in the eastern sector of the park from Lake Mamawi northward along Slave River. Westward were a few signs at wide intervals. According to report, the animals were more numerous toward the western boundary, and markedly so in Caribou Mountain. The latter area, it appears, has at times in the past been a heavy producer of skins. Throughout the region, pelts are said to be of a superior, dark quality, more so than pelts from farther north in the less luxuriant forests of the Hudsonian Zone.

In the winter of 1932, a native, Isidore Simpson, stated that although martens were numerous northward of Peace River four years earlier, they were now exceedingly scarce. Ordinarily he saw no signs, or at most only one or two trails, on any trip from Peace River north to Four, Jackfish, and Thultue lakes. Similar conditions prevailed in the northern area. During the winter of 1933–34, martens were again perceptibly on the increase, notably south of Pierre Lake, along Salt Creek, at Pine Lake, and south to Peace Point. In mid-January a few trails were seen while travelling Little Buffalo River, and again in mixed muskeg and timbered tracts south of Nyarling River. This whole northern area in normal years is said by Indians to be good marten country. During the middle of March several dozen trails, in the aggregate, were crossed at various points between Pine and Conibear lakes. In most cases that winter, indications of martens were observed in high, rolling country of the Alberta Plateau, forested with pure stands of Banksian pine, or in mixed woods of spruce and aspen. The diminution of numbers of late years applies not only to Wood Buffalo Park, but extends over the vast wilderness east of Slave River to at least Fond du Lac.

Martes pennanti pennanti (Erxleben). Fisher.—The fisher is so nearly exterminated in the region at present that not a single well-supported record of its occurrence came to my notice during my two years' residence in the park. Rumors were heard that a few still occur about the headwaters of Little Buffalo and Jackfish rivers and westward to Caribou Mountain. It is said that three fisher trails were seen by an Indian during the winter of 1931 near the Fifth Meridian, north of Peace River. Exwarden D'Arcy Arden stated that a number of years ago a few of the animals occurred about the mouth of Peace River, and along the Chenal des Quatre Fourches. Formerly the species was fairly numerous and generally distributed throughout all suitable areas.

Mustela cicognanii richardsonii Bonaparte. Richardson Weasel.—Normally this weasel occurs in fair numbers, although over a span of years it is subject to perceptible fluctuation.

This is the common weasel of the region and the only one therein, with the exception of *M. r. rixosa*, which is scarce. The Richardson weasel evidently reached a "low" during the seasons of 1925 and 1926. After this a fairly consistent increase in numbers occurred up to the trapping season of 1931. Reports from all districts, the following winter, indicated a decline comparable with the years 1925–26. A comparative scarcity was fully confirmed by personal observations carried out over a wide territory. In January, 1933, while travelling south through the hill country from Pine Lake to Peace River, numerous trails were seen. But here, as elsewhere, relatively little sign is met with on pine-grown sand ridge and rolling upland. Major distribution is invariably confined to lower spruce-aspen parklands, stream-side coniferous belts, and grassy, semi-wooded swamplands. In some of the last mentioned places the weasel was very active, its trails criss-crossing the snow with numerous passages to matted dead grasses below the surface. Here it doubtless subsisted to a large extent on the Drummond meadow mouse. In the more densely forested belts sign decreases. During the winter of 1933 weasels were distributed in about the same relative abundance as the previous season. Over wide areas it was computed that the rate of occurrence did not exceed an average of more than one trail to two or three miles of travel.

In this latitude the weasel turns white about the second or third week of October. A specimen secured on October 22, 1932, was white except for a scattering of dark hairs over the dorsal area. One seen on the 17th of the month the following year had donned full winter pelage. An adult taken on April 26, 1934, was still white except for some brown hair on the face, crown, and neck. The complete summer coat is attained about the middle of May. Some individuals are practically pure white in winter, except for the terminal two-fifths of the tail, which is jet black, but the majority have a suffusion of pale sulphur-yellow over the flanks and, more rarely, over the trunk. A series of 18 skulls of this species was collected at Indian trapper cabins during the two-year period, chiefly at Sucker Creek, Little Buffalo River. Three males in the collection average 316, 85, 40 mm.

Mustela rixosa rixosa (Bangs). Least Weasel.—This diminutive carnivore occurs in the park, but is evidently scarce. It is seldom seen or trapped and a great majority of the residents apparently know nothing of its existence. Inquiries were made at Chipewyan, Fitzgerald, and Fort Smith trading posts, but no skins had been turned in. A half-breed hunter at the mouth of Buffalo River stated that he had once taken this small weasel there and that he had also seen one just west of the north arm of Great Slave Lake. Chief Warden M. Dempsey also saw one in an Indian trap in the central part of the park many years ago. Isidore Simpson asserted that in the past six years he had accidentally caught several in sets made for other animals, between Peace Point and Four and Jackfish lakes. Through the kindness of Warden R. Allan, a hunter's skin of this species (without measurements, or skull) was obtained in May, 1933; it was taken by an Indian the preceding January near Drolet Creek, Peace River.

On January 23, 1933, I saw an unmistakable trail of the least weasel along Pine Lake road, one mile west of Slave River; individual imprints were $\frac{1}{2}$ to $\frac{3}{16}$ inches long, paired at intervals of 6 to 7 inches. During the winter of 1933, three trails were noted in various parts of the park. This represented one *rixosa* trail to each 670 miles of travel during the winter. In two instances the sign was confined to grassy lowlands surrounded by forest, where trails entered tiny holes in short, surface runways of Drummond meadow mice; the other was a trail bearing straight away in thick spruce-aspen forest on high ground.

Preble (1928) took a specimen at Fort Smith on June 21, 1901, in a runway of *Microtus xanthognathus*; another was secured at Fort Resolution, July 13, under similar circumstances. The writer obtained a skull of *rixosa* in April, 1933, from an Indian at Sucker Creek, Little Buffalo River.

Mustela vison energumenos (Bangs). Western Mink.—The mink is a common inhabitant of the park; in certain areas it is even abundant. Relatively few occur in the extreme eastern part, but they abound in the western half, which is swampy with vast areas of muskeg studded with innumerable ponds and lakes. Although conditions there, with sluggish streams and poor drainage, are as nearly ideal as may exist, the species is not uniformly distributed. It

is to be observed in winter that many muskeg ponds apparently are not visited by mink, whereas bodies of water like Conibear, Thultue, Nine, Jackfish, Three, and Four lakes may carry a thriving population. The species is especially abundant about small, swampy-shored lakes adjacent to Caribou Mountain. This attractive mink territory extends in a sweeping semicircle from Peace River to Buffalo Lake, and northeastwardly to include the valley of Nyarling River.

A productive stream is Little Buffalo River, which compares favorably with the Nyarling, and with the lake-dotted district at the headwaters of both streams. Of almost equal importance is the great area of the park south of Peace River, embracing the maze of lakes and streams in the Peace-Athabaska Delta. Ideal conditions also extend westward up Birch River and along tributaries originating in Birch Mountain. No definite information was secured as to the relative abundance of the species in the latter territory, or Caribou Mountain. Evidently the natives do not habitually visit these high plateaus to hunt and trap.

During the bitter cold of winter the mink spends most of the time under the ice. Along the shore below the ice an air space usually occurs, caused by the subsidence of the water from an early winter level when the ice forms. Here the mink prowls and feeds. A portion of the time, however, is spent on the surface, the animals emerging through cracks and faults in the shore ice. When the snow is loose and deep their characteristic, sinuous, trough-like trails may be seen skirting the shores of lakes or streams, or forking off into the depths of the adjoining forest. Probably these wanderings are induced by growing scarcity of food under the ice and taken with the object of preying on creatures in the woods. Anyway, it would appear that such movements are inforced by hunger in mid-winter, or by the mating instinct in March, as the mink is a laborious traveller once deep, feathery snow descends upon the forest. A series of 68 skulls was collected, chiefly at Sucker Creek and Thultue, Four, and Conibear lakes.

Gulo luscus (Linnaeus). Common Wolverine.—The wolverine now occurs sparingly in this region. It is apparently absent from the eastern park sector, but is said to be met with sometimes in the lake area between the headwaters of, and along, Little Buffalo and Jackfish rivers. Reports indicate that a few skins are secured at intervals in this region, as well as elsewhere north and south, but the animal is now generally scarce. No sign of it was personally observed. The species' center of abundance appears to be considerably farther north.

Lutra canadensis preblei Goldman. Mackenzie Otter.—The otter is now exceedingly rare, if not entirely absent in large sections of the park and adjoining territory. As with many other mammals, this condition is particularly applicable to the eastern section adjoining Slave River. From reliable reports it is clear that the species is more numerous in the far west-central part of the park, somewhat less common in the Northwest Territories portion, and scarcest of all in the country south of Peace River.

Warden Dempsey reports fair numbers along the Little Buffalo, Sass, Klewi, and Nyarling rivers. From Indian statements one is lead to believe that in some localities the species is actually abundant. Particularized places include Sass River, "Otter" Lake (southeast of Sucker Creek), and about the headwaters of Jackfish and Little Buffalo rivers. Isidore Simpson informed me that otters were not uncommon in that sector embracing lakes Four, Kennedy, and Three, and the upper length of Jackfish River. A few individuals occur lower down, and also along Birch River and its tributaries. Warden Allan states that he and Warden McDermid saw several otter trails in the winter of 1931–32 about the west end of McNeil Lake. While descending the Little Buffalo River, near Conibear Lake, on the evening of July 22, 1933, Warden F. Dent and I encountered four otters.

On October 19, 1933, two otters were seen by me in Salt Creek, near Cabin 11; this was considered a rare occurrence by the park personnel in such a far eastern locality. These were the only occasions on which the species was personally seen from 1932 to 1934. One skull (N.M.C. 11889) was obtained at Conibear Lake, March 2, 1933, and another (N.M.C. 12043) at Sucker Creek, Little Buffalo River, on April 2, 1933.

Mephitis mephitis hudsonica Richardson. Northern Plains Skunk.—The skunk ranges

freely in all suitable localities, its usual abode being rolling country clothed with woods or shrubbery. Rather unexpectedly, the species was found to inhabit the lowlands, (subject to seasonal inundation) all about the Peace-Athabaska Delta. The natives report them as common during late summer and fall throughout the shrubby-alluvial flats surrounding Mamawi and Claire lakes. One was personally observed on June 24, 1933, roaming about during the day in grasslands of the Birch River Delta. The animal is common along Slave River and over the dry, forested uplands of the Alberta Plateau, which extend unbroken from Peace River to the Salt River escarpment and northwest to Nyarling River. Much of this region is intersected by Banksian pine sand ridges in which den digging is easy. The animal is also found on outlying western spurs, which extend to Jackfish River, lakes Four, Conibear, and Thultue, and in the rugged Ninishith Hills north and south of Little Buffalo River. Unmistakable signs of skunks were noted about dens in numerous widely separated localities of the park.

All skunks observed in this region are of the "long-stripe" variety; the stripes posterially to the fork averaged about two inches in width, continuing then broadly to the face. Although in Eastern Canada "short-stripe" and "star-black" individuals occur commonly enough, none was noted here. Trappers informed me that the latter type of marking does not occur. On April 20, an individual of the "long-stripe" variety was found dead in a sleeping posture under the floor of an out-building at park headquarters; this was a male, weight 3½ pounds; measurements: 660, 250, 88 mm.

In 1932, no skunks, nor their trails, were seen after a snow storm in early October. The next fall, mild weather with rain persisted until the middle of October, with the first snow on the 18th. The animals were noted in numbers, but the majority evidently went into hibernation about this time or earlier. Trails were noted in the snow up to the 26th of the month, however, and on this date two skunks were seen around buildings at park headquarters. A rather freakish occurrence was an animal encountered in deep snow along the Pine Lake road on November 21. Winter conditions had then prevailed for over a month. Trappers say that occasionally a few individuals come out during mild spells in the winter.

During the spring of 1933, the first skunk trail was seen on April 19; snow still lay in the forest a foot deep. By the end of the month the species was active, post-hibernation movement apparently being general. In 1934, a fresh trail was observed in the Ninishith Hills as early as March 20. The same day, two freshly trapped animals were seen at an Indian cabin near Sucker Creek, and another, left hanging in a bush by the trail, west of Flatgrass Lake. Evidently a general but temporary movement had set in, although the weather was not conspicuously mild.

Vulpes fulva abietorum Merriam. British Columbia Red Fox.—At times this species is one of the commonest of native mammals; it ranges everywhere in the region, and during "peak" years occurs in astonishing numbers. As it is active all winter, its trails are among the most characteristic of forest signs. The animals are seen with fair frequency throughout the year. In winter the fox ranges alike in the deepest forest and over the most exposed territory. During my two-year residence, however, it was never so numerous south of Peace River as north of it. Apparently the great delta lowlands were not so attractive as mixed forest, meadow, and plain farther north. In the summer months favorite resorts are along rivers and in sandridge-forested areas of the higher interior uplands. Here they have their dens in banks, or along hillsides. At this season, sandy buffalo trails and wallows may be completely covered with fox tracks. Concentration in highland areas is notable during summer and fall, as vast areas of muskeg ranged over in winter are not then available.

During the trapping season of 1932, the animals were very numerous, but, if anything, they were more abundant the following winter. Several trappers were known to have secured from 75 to more than 100 pelts single-handed during the season. Although admittedly plentiful in Wood Buffalo Park, Salt River Settlement Indians stated that the animals were even more numerous east of the Slave, in country densely populated by migrant barren ground caribou. They believe some significance is attached to this circumstance. It appears that the 1933 season constituted the cyclic "peak".

Two red and one cross foxes taken after New Year's 1934 measure as follows: ♀ 1073, 397, 177; ♂ 1125, 440, 195; ♂ 1090, 420, 185 mm. During the two winters, a series of 32 fox skulls was obtained from Indian trappers at La Butte, Murdock Creek, Sucker Creek, Four, and Conibear lakes.

Alopex lagopus innuitus (Merriam). Continental Arctic Fox.—During some winters these little foxes wander considerably south of their normal range, completely cross the Hudsonian, and deeply penetrate the forests of the Canadian Zone. Trappers and traders reported sporadic occurrences at, or near, Fort Resolution, Fort Smith, Chipewyan, and Fond du Lac. The species was not personally observed in the region. Although the majority here are taken east of Slave River (in the migratory range of the barren ground caribou), several have been seen and trapped west of that stream. Victor Marie, a Salt River Settlement Indian, informed me that several occurred west of that place during the winter of 1930-31; also, that two were taken in red fox sets on the salt plain (within Wood Buffalo Park) immediately west of Salt River and south of the 60th parallel. These, therefore, come definitely within the area especially covered by the present report. It is also said to have wandered into the Le Grand Detour locality, and on plains west of the Little Buffalo and south of the Nyarling rivers.

Preble (1908) records skins observed at Fort Smith, and mentions that about 200 pelts were traded at Fort Resolution, the greater number probably coming from the area east of Great Slave Lake. MacFarlane (1905) states that many years before a white fox was shot a considerable distance up Peace River. Harper (1932) mentions one that was trapped about January 1, 1914, south of Jackfish Lake near the Athabaska Delta. This is apparently the southernmost point of occurrence of which we have any record.

Canis latrans subsp.? Coyote.—The coyote ranges in suitable districts throughout the whole of the park. According to Indian reports, a few stray north of this area and may reach Great Slave Lake. It is certain that the species has increased considerably during the past 40 years. When Preble visited the Athabaska-Mackenzie region, 1901–1904, only an occasional animal ranged so far north. Numerous coyotes and their trails were personally seen in the southern two-thirds of the park. The species appears well distributed in the Peace-Athabaska lowlands, and west all along Peace River to the western boundary. The largest numbers, however, are found in the central part of the park north of Peace River, and particularly in the eastern half. Substantial numbers frequent woods and salt plains west of Slave River, and locally in the more rugged uplands to the west, from Peace River northward about Crane, Pierre, Lane, and Pine lakes to the Northwest Territories. It seemed especially common in the salt plains section west of Fort Smith in September 1933. In January 1934, a few trails were seen on the Lobstick Creek Plain and north along Little Buffalo River. Indians reported scattered individuals in the highlands westward, and northward, to the Nyarling River and also a few in the lowlands of these latitudes between the Slave and Little Buffalo rivers.

On November 25, a coyote, two-thirds grown, was seen in an Indian trap 8 miles northeast of Pine Lake; it was pale-colored with areas on the face, shoulders, flanks, and tail of a light tawny shade. Judging from its small size it was an immature of the year. An adult female (N.M.C. 12319) was secured for the collection on February 27, 1934—taken in a set made for wolves near Murdock Creek. This specimen measured 1310, 360, 220 mm, and by skull characters is definitely referable to *Canis latrans incolatus* Hall. A skin without skull taken by John Bloomfield at Fort Smith in the winter of 1924 shows a trace of *C. l. lestes* or *nebracensis* characters in a faint streak of blackish hairs on the fore legs.

Canis lycaon occidentalis (Richardson). Northern Gray Wolf.—Now, as in olden days, timber wolves range practically throughout the park, but doubtless much below primitive numbers. Definite information is lacking for the southern extremity of the park, yet there is no reason to believe that odd rovers do not occur there also, particularly in the wilds of Birch Mountain and southwest of Jackfish River. Extensive observations made north of Peace River indicate a more or less universal distribution. While some areas appear nearly free, in others the animals are active, particularly from the Slave and Peace rivers north to

Nyarling River and Buffalo Lake. The existence of an influx is indicated by warden reports pointing to a marked increase of wolves in the buffalo range. Evidence of this seems to go back to at least 1925. Some think an invasion occurred with a heavy movement of barren ground caribou into the Tazin Highlands east of Fitzgerald. Evidently wolves have consistently increased since that time.

In the summer of 1932 numerous wolf "sign" and trails were personally observed from the Slave River salt plains to Pine Lake, and occasionally northward to Salt Mountain. Wolf trails, fresh and old, were so frequently seen along the upper Buffalo River in July 1932 that no doubt can arise as to a relative abundance in that quarter. This and other evidence make it obvious that wolves remain in the park all summer, breed, and have a status as permanent residents. They do not, as has been suggested, come and go with the north and south migration of barren ground caribou east of Slave River. Wolf trails also were seen in late July and early August along the Nyarling and up the Little Buffalo River to Lobstick Creek.

Warden reports, in general, indicate a greater number of wolves in the western park sector about and beyond Conibear Lake to Caribou Mountain and northward. Sections of the north-central area west to Copp and Buffalo lakes are of the same character. Such statements are supported by personal observations. Although of late years bands have become more common in the eastern park localities, yet wolves on the whole are less in evidence here, and south of Peace River, than farther to the northwest. During the winters of 1932–33 and 1933–34 wolf packs of 12 to 16 individuals were observed on many occasions by my party, as well as by various wardens. Personal travels of nearly 4000 miles during these two seasons indicated a rate of occurrence of 24 wolves to each 2000 square miles, or about 170 for that portion of the park north of Peace River.

Immediately west of Point Providence wolves were common and breeding during the early part of 1933. A large, adult female was shot here on April 17 by an Indian, and her litter of five whelps was secured. These were just opening their eyes and estimated to be 10 days old. On the 21st of the month Indians of the same locality secured two more wolf litters—one of five and the other of four whelps, calculated to have been born on April 12. In each case the young were found in surface beds at the base of spruce trees in dense forest. It is not clear whether this is a common practice among wolves of this latitude. Normally, they are regarded as having underground dens for this purpose.

As regards the killing of buffalo by wolves, sufficient data are available to prove that the animals are responsible for considerable damage. Of late years Indians and wardens have found many animals destroyed in this manner, the details of which are in the park files. It appears, however, that the majority of wolves reside in territory that is not inhabited by bison, such as in the region of Buffalo Lake and upper Buffalo River or, again, in districts where buffalo occur only sparingly, such as from Peace Point west to Jackfish River and northward to Three, Conibear, and Sass lakes. But this area is rich in moose and other game. In all the wolf excrement examined by me during the summers of 1932 and 1933 buffalo hair was absent, but moose and other hair was common. It is in no wise extraordinary that wolves should prey upon bison. These animals were their regular prey on the prairies of old and the brutes were accordingly called "buffalo wolves" by the first hardy trappers and traders to enter the plains. Probably in the northern forests as on the great southern plains of early days wolves attack chiefly the sick, lame, and aged animals, and unprotected calves when possible. It is a notable fact, however, that so far as we are aware no remains of wolf-killed buffalo calves have been found by the park personnel; probably this is because they are more easily disposed of than adults.

Lynx canadensis canadensis Kerr. Canada Lynx.—During normal years the lynx is a common resident of the park. As its rise and fall in numbers usually reflect a corresponding fluctuation in varying hares, the population differs materially from one period to another; the average length of these periodic cycles has been worked out at 9.6 years (Elton, 1933). As is the case with some other mammals, the lynx is comparatively scarce along the eastern border of the park at Slave River and elsewhere. It appears to increase progressively in abundance to the west. This may possibly be explained on the grounds that more people

and greater activity exist on the eastern side where intensive trapping has been carried on for a much longer period. The fact remains that lynx are almost unknown here during summer and only a few scattered individuals occur here in winter.

The Indians maintain that a seasonal migration occurs in December and January from the west, ostensibly originating in Caribou Mountain or the forested muskeg-plain immediately adjoining its base on the east and north. Whether the theory is correct is unknown, but observations certainly support it. Even as far west as Crane, Lynx, Pierre, Lane, and Pine lakes lynx are not ordinarily present in large numbers until mid-winter. For this reason Indian trappers of this sector seldom distribute lynx snares until mid-December or even January. During a 260-mile journey into the latter district and half way to Conibear Lake in November 1933 the species was found to be scarce. Yet the following January it was common throughout this same area and south from Pine Lake to, and along, Peace River. Numbers hold up well in the eastern fringe of distribution until early spring when the usual scarcity is again manifest, apparently by an ebb westward.

During more westerly journeys in both winters lynx were common from Jackfish to Conibear Lake and more northern points. In January 1934 Indians reported good numbers in the hill country of the northern area between the headwaters of Klewi and Nyarling rivers and westward to Caribou Mountain. In fact, they are said to frequent practically all of the glacial moraines of this sector, as they do the various high ridges of the Ninishith Hills. The Indians put forth their greatest efforts in lynx trapping from January to March. Evidently the animals are much more active at that time, stimulated toward the end of this period largely by the mating instinct. A series of 22 lynx skulls was secured from trappers at Sucker Creek, Conibear, and Thultue lakes.

Marmota monax canadensis (Erxleben). Canada Woodchuck.—This species is rather uniformly distributed in suitable places throughout the region. Characteristic terrain embraces rocky hill country, sand ridges, and well-drained rolling country. One instinctively turns to this type of ground in search of specimens, but the species, while more numerous here, is not confined to it in Wood Buffalo Park. Many woodchucks were seen in timbered, alluvial flats bordering Peace and Slave rivers, and along the banks of small, interior streams.

The woodchuck is fairly common in the Ninishith Hills and in sand ridges everywhere along Little Buffalo River. It also occurs in the limestone escarpment flanking the lower part of the stream from the falls northward to Nyarling River. Numbers likewise occur on the main Buffalo River from near Buffalo Lake to Great Slave Lake. Personal observations, and Indian and warden reports reveal that it occupies all suitable range in the vast, interior uplands of the Alberta Plateau west of Slave River salt plains and escarpment. Favorite locations are, of course, the glacial and gravel ridges that intersect the region. Indians report the animal to be fairly numerous along Peace River, the flanks of Caribou Mountain, and in ridgy terrain southward to Birch Mountain. No definite data were secured as to the period of hibernation at this latitude, but based on a knowledge of general climatic conditions it appears to be from mid-September to late April or early May. Personal records are lacking for September. In 1934 Warden F. Dent first observed the species at Rocky Point, Peace River, on May 3.

A fine, large skin of a male which was captured on September 1, 1932, at the mouth of Buffalo River, Great Slave Lake, was received from Mr. S. S. Marshall. A female that I trapped near Fort Smith on May 20, 1933 (the first seen that spring), contained five embyros three-quarters of an inch long; weight, 2½ pounds; measurements, 482, 117, 70 mm. Traps left set at the same burrows for two days following, without result, indicated that the male had left since mating. Other specimens were collected as follows: Government Hay Camp, June 2, 1933, male, 2¾ lbs., 450, 130, 78 mm; Ninishith Hills, July 23, 1933, female, 4½ lbs., 480, 110, 70 mm; and a male, same locality, 6¼ lbs., 560, 130, 75 mm. One was seen killed by an Indian dog on the edge of the plain at Lobstick Creek, August 1, 1933, but hard travelling left no time for preservation.

Eutamias minimus borealis (Allen). Northern Chipmunk.—Although nowhere abundant, this sprightly creature of the north woods ranges widely west of Slave River. It is apparently absent to the east. The most attractive habitats are in sunny aspen-spruce

forests bordering the larger streams. Thus the greater numbers observed were along Slave, Peace, Buffalo, and Little Buffalo rivers, but under comparable conditions in the Alberta Plateau it may be nearly as common. Where extensive stretches of muskeg occur, even though embracing otherwise suitable wooded "islands" in the nature of isolated flats and ridges of comparatively small area, the species is missing. It was found fairly common in several places along Buffalo River from Great Slave Lake as far as the stream was ascended to about latitude 59°55′. Throughout June and early July 1933, the chipmunk was nowhere seen in the Chenal des Quatre Fourches, Lakes Mamawi, and Claire sector south of the Peace, except westward from Lake Claire. According to reports, a few occur in the Precambrian rock "island" district immediately west of Lake Athabaska and north of Chipewyan.

The species is seldom seen after late September, or early October, according to season; one, however, was observed on October 17, which is an unusually late date for this latitude. Although there was no snow, small creeks and ponds were frozen, while the next day a two-inch snowfall mantled the country. This definitely discouraged any further appearances. In the spring of 1933 the first chipmunk was noted on April 30—a fine, warm day after a cold, stormy period. On this occasion two were collected and five fresh trails were seen in snow still nearly a foot deep in the woods. The movement appeared to be general. In 1934, Warden F. Dent noted the first chipmunk of the season at Rocky Point, Peace River, on May 3.

During the investigations a series of 18 specimens was collected at the following points: Boundary Creek, Buffalo River (lat. 61°31′); Fort Smith; Government Hay Camp; Cherry Mountain (Peace Point trail); and Spruce Point, Lake Claire; these average in size, 208, 95, 31.5 mm. The largest individual taken measured: 217, 99, 32 mm.

Tamiasciurus hudsonicus preblei A. H. Howell. Mackenzie Red Squirrel.—The red squirrel abounds in the better coniferous belts throughout the region. In consequence, it is attracted in largest numbers to those woods that have their greatest development in the vicinity of lakes and streams. It was commonly observed in suitable localities from Chenal des Quatre Fourches and Birch River north to Nyarling and Buffalo rivers and Great Slave Lake. While more numerous in spruce or spruce-poplar forest on river lowlands, it may be found in fair abundance under locally attractive conditions all over the Alberta Plateau. Based on park observations, it is normally scarce in pure pine forest of large area. Yet in a few places of this nature, such as at Fort Smith and Cherry Mountain, it was locally as common in the pines as elsewhere.

During the intensely cold, short days of midwinter red squirrels are quiet and relatively inactive. While always up and about to a certain extent, much more time is spent underground. Scarcity of snow trails, with fresh signs only at feeding stations, is evidence that the days then are spent chiefly below ground with occasional sallies in the open to shell cones brought from below. At this time of year one may travel long distances in good squirrel country without hearing or seeing a single individual. Squirrels in pairs were particularly noticeable after March 15, specimens taken proving association of the sexes. In one instance six squirrels were collected from the same group of holes at a feeding station, the sexes being equally represented. It would appear that in some cases the species resort in sociable colonies, but it is customary to see but a pair in one place. By early March the testes of the males are very large and the animals are characterized by a musky odor. In the only case observed copulation took place on May 9, 1934. There is evidently but one litter each year, as no foetuses were seen in any females collected during the spring months previous to this time, nor in any taken later in the summer or fall.

A series of 65 specimens was collected in the park at various times, including complete summer and winter pelages; these were secured chiefly at Government Hay Camp, but others were taken at Junction Lake; Buffalo River forks (lat. 59°55′); Boundary Creek, lower Buffalo River, and Lobstick Creek. Four hunter's skins in winter pelage taken at the mouth of Buffalo River (Great Slave Lake) were kindly presented by Mr. S. S. Marshall; these lack skulls and measurements. The other specimens average in size: 313, 118, 51.7 mm; the largest example (male) measures: 346, 140, 52 mm.

Glaucomys sabrinus sabrinus (Shaw). Hudson Bay Flying Squirrel.—This elusive crea-

ture, due to its nocturnal habits, is seldom encountered. In addition, it appears from all known circumstances to be rather rare but widely scattered throughout the park. Under such conditions a collector's efforts are apt to end in failure, except possibly for a rare, accidental catch. In good flying squirrel territory many of these animals blunder into traps set for valuable fur, and are regarded by trappers as "trash" along with red squirrels, Canada jays, and hares; it was not learned that the present species was often taken in this manner in Wood Buffalo Park.

Warden F. Campbell stated that several visited the park storehouse at the 30th base line (winter of 1931) causing considerable damage to biscuits until trapped out. Warden D'Arcy Arden reported an occasional animal at Rocky Point, Peace River, and Peace Point; Jackfish Indians asserted that small numbers resorted to woods along Peace and Jackfish rivers. William Clawhammer stated that a few flying squirrels lived in heavy spruce timber along the Little Buffalo and Nyarling rivers where a few were taken accidentally in marten and lynx traps. A hunter's skin was contributed by Mr. S. S. Marshall, taken at the mouth of Buffalo River, Great Slave Lake, in September, 1932. I observed the species on one occasion when an individual entered the store house at Government Hay Camp on April 7, 1934. It was trapped that night and proved to be a female measuring 315, 147, 42 mm.

Castor canadensis canadensis Kuhl. Canadian Beaver.—Wood Buffalo Park embraces a territory of ideal character for beaver and they have taken full advantage of the protective measures that have been in force for many years. The species is well distributed, even abundant in certain north-central and western localities in the park, and continues to increase. Where beaver have not been known locally for a decade or more, today sees them taking up quarters in ponds and insignificant streams that with a depleted population would be ignored.

Many beavers were seen on Net River; on Buffalo River as far as it was ascended to the forks in latitude 59°55′; along Copp Creek; and throughout the length of Little Buffalo and Salt rivers. Fair numbers also inhabit Nyarling, Klewi, Sass, and Jackfish rivers, together with the numerous smaller streams tributary to them, and the Peace and Slave rivers. Hundreds of ponds and lakes have a comparable abundance. Indians repeatedly refer to the consistent distribution of beaver throughout the lake-sprinkled region northward from Conibear Lake and northwest from Thultue to Buffalo and Copp lakes. In fact, the whole eastern sector in a sweeping semi-circle adjacent to Caribou Mountain, north of the Peace, is ideal for the species. The eastern portion of the park south of the Northwest Territories supports a much smaller population, but reoccupation there is now gradually taking place.

The greatest concentration personally seen was on the Little Buffalo River from Thultue Lake to the canyon in the Northwest Territories. In this distance 70 dams and 95 houses were counted. The lodges did not represent the total population of the river course here as considerable stretches had dams and abundant cuttings where no lodges existed, indicating that the beavers lived in the banks. A conservative estimate would give this stream from Thultue Lake to the falls a population of not less than 1,000 beaver. The animals are more plentiful from Sucker Creek up, than farther down stream. Ponds and lakes in adjacent country are well stocked, particularly westward from the Ninishith Hills.

Two immature female beavers were collected in small lakes immediately south of Pine Lake on June 14, 1932; these have the following measurements and weights: 780, 278, 155 mm., 15½ lbs.; 810, 280, 165 mm., 18½ lbs. A single large beaver skull was also secured at a trapper's cabin near Sucker Creek. A full account of the species in Wood Buffalo Park is given in an earlier paper (Soper, 1937).

Peromyscus maniculatus borealis (Mearns). Boreal White-footed Mouse.—This is one of the more familiar small mammals of the region. Not infrequently it rivals in abundance *Microtus* and *Clethrionomys*, according to locality. In particular, the species haunts mixed forest of down timber and interspersed shrubbery. Intensive trapping reveals that in this region it is more plentiful in the better wooded tracts bordering lakes and streams; mixed second growth and brulé comes a close second. The creature is adaptable, however, and may be secured in varying numbers from the gloomiest of spruce forest carpeted with mosses to the sunniest of glades and meadowlands fringed and dotted with willows and alders.

As an example of the latter, it was found a common summer inhabitant of the low, grass-willow lands bordering the east side of Mamawi Lake. There in late August, 1932, 45 trap-nights produced 18 individuals. Peak catches on unit areas at Government Hay Camp the same year gave evidence of a population as high as 46,400 animals to the square mile. Investigations proved conclusively that the species not only had a peculiarly erratic distribution, but also that it varied in abundance from year to year. Thus it was found much scarcer in 1933 and 1934, than during the summer of 1932. In 1933-34 extensive trapping was conducted for *Peromyscus* of the Alberta Plateau when not a single specimen was taken for days on end. Again, during the first three weeks of September, 1933, a saddle horse journey was made from Slave River to Pine Lake, north in the rolling uplands to Salt Mountain, and south to Cherry Mountain, Moosehorn Slough, and beyond; an average of 45 traps was distributed every night, yet in this period not a single example of the species was taken.

During the course of the survey *borealis* was collected at Government Hay Camp; 30th Base Line, Slave River; Rocky and Peace Points, Peace River; Lakes Mamawi and Claire; Jackfish River; Conibear and Pine Lakes; Buffalo River forks (lat. 59°55′), and Boundary Creek (lat. 60°31′); Lobstick Creek; Fort Smith; and Ninishith Hills. A series of 34 specimens in the collection averages 159, 70, 20.2 mm; the largest, a female, measures 182, 77, 22 mm. Curiously enough, six consecutive adults taken at Government Hay Camp in August, 1932, had a foot length of 22 mm; the seventh, 23 mm. At no other point was a specimen preserved with a foot length exceeding 21 mm.

Synaptomys borealis borealis (Richardson). Richardson Lemming Mouse.—This species constitutes one of the rarities of the park. A conservative estimate for the two-year period places the number of "trap-nights" at 7,500; yet in all these operations only five specimens of *Synaptomys* were secured. The first was captured at Lobstick Creek, August 2, 1932, in a dry, wooded tract of brulé character, somewhat grass-grown and interspersed with second growth spruce and poplar. More than a year passed before the next specimen was secured on September 4, 1933, near Salt Springs, 16 miles southwest of Fort Smith. In this case the capture was made in thick, gloomy spruce woods at the base of Salt Mountain escarpment; the whole immediate area was deeply carpeted with sphagnum mosses, overgrown with Labrador tea. The next and last specimens were secured at Moosehorn Slough on September 12, 1933, when three individuals were taken in a small area in a single night. The situation was rather marshy, with grass and willow clumps bordering the slough, and close to the edge of mixed forest. The average measurements of the five specimens are: 108.6, 19.4, 16.8 mm.

In 1901, Preble (1908) trapped a specimen in a *Microtus* runway on the border of a small meadow near Slave River, 25 miles below the mouth of the Peace; later, two in a wet swamp near Fitzgerald. R. M. Anderson, National Museum of Canada, trapped two in Wood Buffalo Park, one (no. 8749) at "Big Poplars", Sept. 16, and another (no. 8757) in a slough near Salt River, 10 miles west of Fitzgerald, Sept. 30, 1927. The scarcity of the species accounts for its absence from the lists of several writers who have reported on the mammals of the Athabaska-Mackenzie region.

Phenacomys mackenzii Preble. Mackenzie Phenacomys.—This animal was not secured during the park investigations, although the area lies entirely within its known range. After diligent and fruitless efforts to detect it in many localities, the only logical conclusion is that the species was experiencing a pronounced "depression" during the 1932-34 period. The type locality of the race is nearby Fort Smith, N.W.T., where Preble (1908) took a series of 25 specimens during the last few days of June 1901. He says they were captured in a strip of dry spruce and poplar woods bordering a marsh. Many of them were taken beneath the clumps of buffaloberry (*Lepargyraea canadensis*) that helped to form a sparse undergrowth. While camped in the type locality, May 18-23, 1933, I made a determined effort to secure topotypes, but without result. As exactly the same kind of ground was covered as described by Preble, negative results further lend support to the theory of great scarcity at this time. With special reference to Wood Buffalo Park, Preble took a female *Phenacomys* on June 11, 1901, at Slave River, 10 miles below the mouth of the Peace. This was in poplar

woods and from the description close to the point now occupied by park cabin no. 6, 30th base line.

Clethrionomys gapperi athabascae (Preble). Athabaska Red-backed Mouse.—As a rule the collector will find no difficulty in securing an ample series of these animals anywhere in the region. They occupy ground of diverse character although the typical habitat is dry, mixed forest with underbrush open to the sunshine. These qualities exist extensively along the principal rivers and in large areas of the Alberta Plateau in the central interior of the park. In such places the species occurs in greatest abundance. Locally, it may also be taken in dense, moss-floored spruce forest, pure stands of aspen or balsam poplar, and in thick shrubbery bordering lakes and streams.

In 1932, it was common nearly everywhere, particularly in the more typical situations. Thus at Government Hay Camp, Slave River, it abounded in mixed spruce-aspen woods; long trap lines often yielded as high as a 40 to 50 percent catch. In thick poplar woods at Pine Lake, June 1932, 16 "red-backs" were taken from 30 traps in a single night; and at the Buffalo River forks (lat. 59°55′) in heavy spruce-poplar forest, 40 examples were taken in 100 trap-nights in July 1932. Studies were made for a unit area count in average mixed woods at Government Hay Camp, Fort Smith, Junction Lake, and Spruce Point, Lake Claire. The results indicate from 8,300 to 16,500 red-backed mice to the square mile.

Fort Smith, N.W.T., is the type locality of *athabascae*, the type specimen being collected by Edward A. and Alfred E. Preble on June 27, 1901. In that year they found the race common at their several camps from Chipewyan along the Slave to Fitzgerald, Fort Smith, and Great Slave lakes. In late May 1933 I spent six days in the type locality and preserved 11 topotypes. As these were all that were captured, the species was obviously much less common there than in 1901. At Government Hay Camp, where more detailed observations were made over a longer period than elsewhere, trapping returns indicated a decrease in the fall of 1933 in comparison with the previous summer; this was even more pronounced for the spring of 1934.

Specimens of *athabascae* were taken at Spruce Point, Lake Claire; Government Hay Camp; Cherry Mountain; Pine Lake; Junction Lake; several points on Buffalo River, above and below Buffalo Lake; Lobstick Creek; and Fort Smith; it was also secured at many other points where specimens were not preserved. The average measurements of 71 individuals from the region are: 128.6, 32.8, 18.1 mm. Eleven topotypes from Fort Smith average: 130.9, 32.6, 17.6 mm; the majority of these are obviously immature in comparison with specimens from other places and with the measurements of 10 adults given by Preble (1908) from the type locality, which average: 142, 38, 18 mm. The largest example of the race taken in the park (Boundary Creek, Buffalo River) measures 151, 38, 18 mm. A slaty-brown phase of coloration, affecting the dorsal region, is found in specimens from the park, but this is of low percentage in comparison with individuals of normal pelage.

Microtus pennsylvanicus drummondii (Audubon and Bachman). Drummond Meadow Mouse.—During peak years this is probably the most abundant small rodent of the region. Due to its colonizing habits, with great local concentration of numbers, it is much more in evidence to the casual observer than any other small and relatively obscure member of the Rodentia. In the better years the animal is exceedingly common in suitable situations throughout the park. As one would expect with such an adaptable creature, *drummondii* may be found under many local conditions. The most acceptable and most familiar habitat, however, embraces luxurious meadows. In 1932–33 it was locally abundant in meadows along Slave River and throughout the salt plains westward from Hay Camp and La Butte. Plains situations occupied by these mice may be either crisply dry or so wet as to be actually marshy. In these localities censuses were made on the basis of unit areas; the results indicated a potential population of as high as 70,000 meadow mice to the square mile.

A series of 50 specimens of *drummondii* was collected in Wood Buffalo Park at the following localities: Government Hay Camp; Salt Plain, 10 miles west; Salt Creek (Cabin 11); Pine, Junction, and Conibear lakes; upper Buffalo River; Boundary Creek (Lat. 60° 31′); and Little Buffalo River at Lobstick Creek. These have average measurements of 139.6, 38.1,

19.1 mm; the largest specimen, a female, taken at Buffalo River (Lat. 60° 8′, Long. 115° 10′) on July 16, 1932, measures 183, 52, 20 mm. The species was collected at many other points from Lakes Mamawi and Claire north to Nyarling River, where for lack of time and the necessity for selective preservation of other forms of more importance individuals were not retained.

Microtus xanthognathus (Leach). Yellow-checked Meadow Mouse.—Although the most assiduous attention was given to its detection in the park, no specimens of this meadow mouse were secured; nor were any undoubted burrow colonies anywhere seen. The animal is of particular interest to naturalists as it is apparently local in occurrence, undoubtedly rare or absent over extensive areas, and commonly eludes individual collectors. Warden Dempsey is of the conviction that a colony of these large voles occupied a dry, poplar tract of woods about an old log cabin at Government Hay Camp during the summers of 1930 and 1931. In August 1932 I placed a large number of traps in this area without securing specimens. While ascending the Nyarling River in July 1932 a heavy-set mouse, much larger than any *drummondii*, was glimpsed as it ran up the bank to the woods; it was almost certainly one of these animals. Along the Little Buffalo River, in latitude 60° 31′, signs attributed to *xanthognathus* were seen in a marginal zone between spruce-aspen forest and grass-willow lowland; the unfamiliar coarseness of trails, cuttings, and feeding stations, pointed distinctly to an animal larger and heavier than *drummondii*. The numerous felled stalks of *Equisetum* also suspiciously suggests this animal, for Preble (1908), says: "The favorite food of *xanthognathus* seemed to be the stems of *Equisetum*, which grew luxuriantly in their haunts." No burrows were seen here. Unfortunately, the necessity for rapid travel in both the above instances prevented lingering to set traps. In the summer of 1901 Preble (*loc. cit.*) secured a series of specimens at Fort Smith, and Fort Resolution; the measurements of 10 adult specimens from the former locality average: 212.6, 52.8, 24.5 mm.

Ondatra zibethica spatulata (Osgood). Northwestern Muskrat.—This interesting rodent is commonly distributed throughout the region. In parts it occurs in amazing abundance, exhibiting highly prolific reproductive tendencies in the face of persistent seasonal trapping. It is much more plentiful in the lowlands south of Peace River, immediately westward from Lake Athabaska, than elsewhere in Wood Buffalo Park. During an average season about twice the number of pelts are taken in this restricted sector than in all the rest of the park put together. On good authority, it appears that during a peak year between 70,000 and 90,000 muskrat skins are traded at Chipewyan alone; the majority of these are derived from the Peace-Athabaska Delta.

The typical home of the muskrat embraces the great marshes. Yet numbers of them inhabit the central and northern sections of the park. In July 1932 they abounded in the creeks, rivers, and marshes everywhere about Buffalo Lake. As far as the Buffalo River was ascended toward Caribou Mountain, a profusion of sign signified an unmolested and thriving population. The species was also abundant along Nyarling and Little Buffalo rivers and in most of the food-bearing ponds and lakes on the Alberta Plateau. Few muskrats are seen in the larger rivers, such as the Peace and Slave; the current on the whole is too swift and the banks too clean and destitute of food and cover. In the more sluggish waters of the Rochers, Revillon Coupe, and Chenal des Quatre Fourches the species finds more congenial surroundings. This is also true of many quiet streams, such as Murdock and Salt creeks and Salt River.

Even in this latitude, trappers maintain that the species has two or more litters of young each summer, breeding early and late. Some are inclined to the belief that the first-born young of the spring breed and have young before the following winter. It is true that rats in many stages of growth may be collected throughout the summer and fall. Early in October 1932 a small example of a one-third grown animal was taken; throughout this month and into November the majority appear to be immature. A preponderance of mature animals is naturally secured in late winter and early spring, which, together with the late primeness of fur, is a logical argument against fall or early winter trapping.

Zapus hudsonius hudsonius (Zimmerman). Hudson Bay Jumping Mouse.—Park investigations showed that the jumping mouse was universally scarce. Indifferent success attended careful trapping for it in a multitude of localities throughout the area; only one specimen was secured. This was taken at Conibear Lake, July 20, 1933; male, 212, 126, 29 mm. It was trapped in a damp area of grass and willows bordering the north shore. A flat skin, without skull, taken at the Government Dog Camp, east shore of Mamawi Lake, on August 10, 1932, was obtained from Warden D'Arcy Arden. Most people consulted seemed to have no knowledge of this species. In 1901, Preble (1908) took several at Fort Smith and two at Fort Resolution. Macfarlane (1908) says that early in the sixties of the nineteenth century the Smithsonian Institution at Washington received several examples from Liard River, Fort Resolution, and from Peace River; he is of the opinion that it is very uncommon in these localities. Seton (1911) does not list the species in the results of his 1907 expedition to this region. Harper (1932) saw a jumping mouse at the edge of a slough in the buffalo range about 30 miles southwest of Fort Smith. The records indicate that *Zapus* is sparingly distributed in these northern forests.

Erethizon epixanthum epixanthum Brandt. Yellow-haired Porcupine.—The wardens informed me that porcupines inhabited the area, although they were comparatively rare. This was fully borne out by personal experience, as only one live example was seen during the two years. In a country of many porcupines, girdled trees are a common feature; scarcity of the animals in the park is further demonstrated by the fact that these signs are rarely observed. The only specimen secured was an adult female taken by Warden R. Allan for the collection at Pine Lake, June 11, 1932. In September 1931 Warden C. Cooper saw two yellow-haired porcupines on the edge of the meadow at Government Hay Camp. Wardens R. Allan and J. Taylor reported having seen individuals rarely over a span of several years at Junction and Pine lakes, and along the trails west to Conibear Lake and south to Peace River. Every one of these is said to have been the yellow-haired variety.

Warden D'Arcy Arden, as well as several Chipewyan Indians, reported porcupines along Peace River and south of lakes Claire, Mamawi, and Athabaska. Leon Houle (Salt River Indian) says that according to his experience the species is scarce in that district and westward beyond the Little Buffalo River; on the contrary, however, he states that it is not uncommon locally in the same latitude east of Slave River. This was evidently in the vicinity of "Hanging Ice," the Tethul River, and possibly the Taltson, where he sometimes ran a trap line. A few individuals also inhabit the northern park area between Klewi and Nyarling rivers. In early September 1933 I saw two porcupine trails in dusty buffalo wallows between Cherry Mountain and Moosehorn Slough and on the 12th of the month a live animal was encountered in the same district. This individual was quite dark, but the dorsal quill tips were of a light lemon-yellow coloration.

Preble (1908) saw no porcupines during the course of his journeys in the Athabaska-Mackenzie Region. Under *dorsatum* he says (p. 197) that the animal was reported fairly common north of Chipewyan and in the region about Fond du Lac, with a few about the eastern end of Great Slave Lake; under *epixanthum* (p. 198) are reports of occurrence at Fort Simpson, Liard and Peel Rivers, and along the Mackenzie as far north as latitude 67°. The dividing line between the two species is probably a short distance east of the park in the Tazin Highlands. Neither Seton (1911), nor Harper (1932) observed porcupines during their travels in the North, although the former, under *dorsatum* (p. 346), mentions a number of reported occurrences within the region. R. M. Anderson saw a large specimen of *epixanthum* on September 20, 1927, near the trail to Moosehorn Slough, on top of a low wild-rose bush eating the rose-hips (pseudocarps), which were said to be unusually large and abundant that season.

Lepus americanus americanus Erxleben. Varying Hare.—From 1932 to 1934 the varying hare was common in most sections of the park. With exceptional opportunities for observation, it was found that by far the denser population occurred in the eastern portions, where better mixed woods thrive on rolling terrain of the interior uplands or along the various

waterways. Thus, for example, hares are much more numerous along Peace, Slave, and Little Buffalo rivers, and their tributaries, than in the vast muskeg lands in the western sector of the park.

Recent studies by Elton (1933) show the periodic fluctuations in the abundance of hares to occur on an average every 9.6 years. According to information secured from Warden Dempsey, the preceding "high" in Wood Buffalo Park occurred during the winter of 1922–23; the following summer and winter the animals died off in great numbers and for several years were scarce. Evidence of revival was manifest in the summer of 1931; the species evidently reached another "peak" during the winter of 1932-33. The writer observed no marked diminution of numbers the following season, although locally some of the Indians asserted that "rabbits" were scarcer than the year before.

From all accounts, the varying hares even in these more northern regions have two or three litters of young each season. Warden D'Arcy Arden informed us that an Indian snared a female at Lake Mamawi on February 12, 1932, which contained five embryos well developed and fully haired; these he thought would have been born in about ten days. This is doubtless a very exceptional case. The first date on which young of the season were personally observed was near the middle of June. They were about one-quarter grown and capable of running freely about the woods. Others of similar size have been seen in August. A young hare collected at Revillon Coupe on June 14, 1933, is 180 mm in length, or not more than one-third adult size.

In this latitude the animals begin to assume the winter pelage in late October. Large numbers are still brown over the back during the first week of November, although the complete change for the majority occurs around the 10th of the month. In 1932 the first wholly white individual was seen on November 7, while the next year this was on the 10th. The first pale suffusion of summer brown is observed dorsally on some individuals about April 15; transition is not general, however, until after the 20th. About one month is required to effect a complete change from winter to summer pelage. On May 23, 1933, a hare was taken in full summer coat, but others were seen the same day still possessing patches of old winter fur.

A series of ten adult hares was collected at Government Hay Camp, Slave River; these, while evidently closer to *americanus*, are more or less intermediate between this race and *macfarlani*. Identity would be more satisfactory with a larger number of summer skins from all parts of the park. Average measurements of the series are: 444.2, 26.6, 132.9 mm; the largest specimen measures 467, 35, 142 mm.

Lepus americanus macfarlani Merriam. Mackenzie Varying Hare.—The remarks under *americanus* also substantially apply to this race. Little data were obtained that throw additional light on the question of the ranges of the two races of *Lepus* that occupy the region under review. It appears that *americanus* may occur in the southern part of the park in typical form, and that *macfarlani* penetrates from the north into that portion of it lying at least in the Northwest Territories. Specimens taken at Government Hay Camp, Slave River, are more nearly referable to *americanus*, although they show intermediate characters between the two races.

Two immature hares taken at Lobstick Creek, N. W. T., on August 1, 1932, are referred by Dr. R. M. Anderson to *macfarlani*; these measured, respectively, 174, 14, 48, and 169, 15, 49 mm. They are heavily furred and of a dark, sooty-brown color, this being overlaid by whitish guard hairs imparting a grizzled appearance; sides of nose, cheeks, legs and feet paler; pronounced whitish area of small size on the crown of the head. These two were from a litter of six that was found in a shallow nest under shrubbery in mixed woods of spruce and aspen poplar. They were doubtless still being nursed as, when found, they were obviously occupying the original nest and made no effort to escape. When released in the tent, however, all were capable of running vigorously. Hares were abundant in all suitable sections of the northern area of the park from 1932 to 1934.

Cervus canadensis canadensis (Erxleben). American Wapiti.—The American wapiti, or elk, is not known to occur now anywhere within this region. According to information

secured from the Indians, it appears that a long time ago the animal occurred in some numbers along Peace River west of Jackfish and southwardly to Birch Mountain in country now embraced by Wood Buffalo Park. Evidently it never ranged into the park beyond the extreme southwestern portion. Preble (1908) cites some early records from Harmon and Richardson to show that 100 years ago the wapiti ranged along Peace River as far east, at least, as Vermilion Chutes; a little farther west it occurred to about the 59th parallel of latitude.

Odocoileus hemionus hemionus (Rafinesque). Mule Deer.—An interesting faunal feature is the comparatively recent invasion of the mule deer, or "jumper," into Wood Buffalo Park. Up to about 1922 the species was not known there. It now ranges practically throughout the park and northward as far, at least, as Great Slave Lake. When Preble wrote his great work on the Athabaska-Mackenzie region in 1908, the northernmost record of the species was apparently in the vicinity of Stony Rapid on the Athabaska, about 200 miles by the river below Athabaska Landing. In the intervening period, it is clear that the species has not only become more plentiful but has greatly extended its range northward.

Spoors, or the animals themselves, were personally observed in numerous widely-separated localities. In 1932 a fine animal was seen at La Grand Detour, Slave River. While ascending the Buffalo River in July 1932, many tracks and two individuals were seen between Great Slave and Buffalo Lakes, while four animals were noted on the upper river to the limit of investigations at the forks of the stream in latitude 59° 55′. Sign in general proved that the species was fairly common in this region. Mr. S. S. Marshall informed us that he had observed the species in the vicinity of Buffalo River at Great Slave Lake within the past year. Tracks were noted in several places along the Nyarling and Little Buffalo rivers.

On many occasions mule deer were seen in the woods west of Slave River between Fitzgerald and Peace River. In August 1933, fawn tracks, mingled with those of adults, were observed on two occasions north of La Butte. During the same summer many adult spoors were noted westward to Pine and Conibear lakes; in the Ninishith Hills; in the vicinity of Little Buffalo River at the falls; and near Lobstick Creek. At the last locality, Leon Houle killed three "jumpers" during the fall and winter of 1932-33. While not plentiful, the species is more common in the eastern portion of the park and along the Peace and Birch rivers than elsewhere in this territory. Warden Allen reported that mule deer were well distributed along the Peace from Jackfish to the fifth meridian in the fall of 1933. Three mule deer were personally observed when I spent a few days on Birch River in June 1933, and this, together with sign noted along the river bars, leaves no question as to the relative abundance of the species in this quarter. Of recent years the animals have been observed many times along the portage road from Fitzgerald to Fort Smith, and westward to the Salt Plains along the base of Salt Mountain escarpment.

Alces americana americana (Clinton). American Moose.—This magnificent creature is more or less commonly distributed throughout the region. In some portions, however, it exists in larger numbers than in others; in the northern and western parts of the park, for example, the species is much more abundant than anywhere in the vicinity of Slave River. In the summer of 1932 I saw many moose and an abundance of sign all along Buffalo River from Great Slave Lake to the forks of the river in latitude 59° 55′; also along the Lilypad and Nyarling rivers and to a lesser extent in the vicinity of Little Buffalo River. In no part of the park were moose subsequently seen to be so numerous as about Buffalo River and Lake. This may be owing in part to the greater remoteness of this district from continued human activity and from long-established settlements such as exist along Slave River.

The upper length of Little Buffalo River and about the Ninishith Hills and Conibear and Thultue lakes is also outstanding moose country. A belt along the north side of Peace River from Point Providence west is evidently second only to northwestern localities in its production of these animals. In a single year the average kill by the park Indians is approximately 400 to 450, yet this has little or no appreciable effect upon the moose population from year to year; the species continues common, if not actually abundant over wide areas. From mid-winter until spring there appears to be a pronounced movement of moose

from western park sectors to the vicinity of Slave River. During summer, fall, and early winter, the animals are rarely met with there, yet by early spring they are common. As the snow goes the movement is ostensibly west again, as in a few weeks the animals almost totally withdraw, ordinarily not to be seen again for another year. Regular year round moose country is entered only about 40 to 50 miles west of the river. This condition applies particularly to that section lying between Peace River and Fort Smith.

On March 15, 1934, two moose foetuses, which had recently been removed from separate females killed in the vicinity, were examined at an Indian trapping cabin at Conibear Lake. One of these measured 12 inches and the other 19 inches in length. While perfectly formed in every detail, the uniformly pink skin carried no sign of hair in either instance. According to Indian information, moose give birth to their young in this region during the latter part of May. There may be a discrepancy of two or three weeks as between the birth of calves of different parents, as is suggested by the great dissimilarity in size of the two foetuses mentioned above for the same date.

Evidently moose do not yard in this region. I had the advantage of travelling more than 4000 miles in most parts of Wood Buffalo Park during two winters, yet in no single instance did I witness the slightest evidence that moose truly yarded at any period of the winter. Trails were invariably at random through the forest, although, occasionally, in highly favorable localities these were markedly concentrated. Based on the character of timber wolf "sign" it is evident that these animals prey upon moose regularly, especially during the colder months of the year.

Rangifer caribou sylvestris (Richardson). Western Woodland Caribou.—Although this species formerly ranged throughout the entire area now embraced by the park, it is today very scarce, or entirely absent, in the eastern and southern portions. No information could be obtained to show that in recent years a single animal had been seen anywhere south of Peace River, nor over an extensive area north of it, and west of Slave River. During the past 20 years the easternmost records of occurrence appear to be for only a few scattered individuals in the vicinity of Sucker Creek, Ninishith Hills, and McNeil Lake; movements are patently erratic from year to year. As a rule, however, a number appear each winter in the territory about the headwaters of Jackfish and Little Buffalo rivers and irregularly northward to Copp and Buffalo lakes. Occasional wanderers still move as far east, in winter, as Kennedy, Four, Conibear, Sass, and Klewi lakes.

It is understood that the above distribution in the park applies only to the winter months and that the caribou withdraw westward for the summer. It is the general supposition that the animals spend the summer in the highlands of Caribou Mountain and spread out over the adjacent forested plains after the freeze-up. In November 1932 the Indians reported woodland caribou fairly common about Jackfish Lake and in a northwesterly direction to the headwaters of Buffalo River. By late December a pronounced movement carried many animals as far east as Kennedy, Six, and Conibear lakes. This was followed in January by a trek westward, which, according to the natives, took the majority of the animals back to Caribou Mountain. Thereafter, until early April, only a few individuals were encountered in the lowlands of the west. On February 2, 1933, I saw tracks of three caribou on Lake Six—the only signs personally observed all winter. Isadore Simpson, a native of Peace River, undertook to obtain a pair of caribou for the collection; arrangements were made with him in January 1933 and on March 23 following he was successful in taking a male and female about six miles northwest of Jackfish Lake. Skins and skulls were forwarded to park headquarters in April; unfortunately the specimens lack measurements. These have been referred by Dr. R. M. Anderson to the race *sylvestris*.

On August 2, 1933, Leon Houle, a Salt River Indian, stated that a few days before he had seen three woodland caribou near Lobstick Creek, and that two years earlier he had killed one in the same locality. The summer occurrence of caribou in this district is unusual. Early in January 1934 William Clawhammer secured four of these animals near the Klewi River, about 10 miles west of the Little Buffalo. He states that nearly every winter a few wander into the northern area of the park between the Klewi and Nyarling rivers. Sousa

Marie, of Salt River Settlement, informed us that the species was tolerably common along his trap line, during the winters of 1932-33 and 1933-34, from the upper waters of Sass River west to Copp Lake and Buffalo River. The animals continued there in numbers until late March when they then moved southwestward to Caribou Mountain for the summer.

Rangifer arcticus arcticus (Richardson). Barren Ground Caribou.—By early December 1932 large bands of barren ground caribou had migrated south to a point east of Fort Smith and Fitzgerald. In late January numerous scattered herds were reported by Indians and white trappers as having reached localities east of Slave River as far south as the 30th base line; still farther east the species was said to be common along the north shore of Lake Athabaska to and beyond Fond du Lac. Salt River Indians reported that numbers crossed Slave River and resorted to plains and woods between Lobstick Creek and La Grand Detour. Trails were also observed south of Ryan Island leading across the Slave into Wood Buffalo Park, thereby providing a definite record of occurrence of this species within the park area. In the winter of 1932-33 the Indians reported caribou to be exceedingly abundant from Tethul River east about Tsu Lake and Taltson River.

During the following winter (1933-34) *arcticus* appeared again in this territory in equally large numbers. On January 8, 1934, Mr. J. M. Streeter reported that two bands of about 30 caribou each had crossed Slave River from the east in the vicinity of Stony Islands, and Buffalo Landing, respectively. He said the animals had fed extensively on goose grass along the river bank on the park side of the river and then returned to the east. On March 1, 1934, I observed three caribou trails that crossed Slave River in the neighborhood of Caribou Island. Evidently the animals barely touch the country west of Slave River anywhere south of Fitzgerald, as no one has observed their sign in the park except close to the river. It is clear that the species prefers rugged rock and moss country with sparse timber and many openings, such as obtains in the Tazin Highlands east of Slave River. At any time during the winter the majority of the herds are found in this type of country and, according to report, are massed at a minimum distance of from 20 to 30 miles east of Slave River.

Bison bison bison (Linnaeus). Plains Bison.

Bison bison athabascae Rhoads. Wood Bison.—For convenience in dealing with the bison of Wood Buffalo Park, the following remarks essentially apply with equal force to the representatives of these two races, which now are intermingled practically throughout the length of the park. Since time immemorial, until a few years ago, *athabascae* occupied the country in pure form. Investigations made in 1920-21-22 indicated that about 1500 wood bison existed in the region. The more recent distribution of the race was found to be westward from Slave River to about Conibear and Sass lakes and from Peace River north to localities between Nyarling River and Great Slave Lake. The more important recent information concerning the wood bison is to be found in the writings of Preble (1908), Seton (1911), Hewitt (1921), Graham (1923), Seibert (1923 and 1925), Kitto (1924) and Raup (1933).

In order to preserve this surviving buffalo herd under continued primitive conditions the Dominion Government set aside an area of 10,500 square miles north of Peace River in 1922, to be known as Wood Buffalo Park; 3,625 square miles of this lay in the Mackenzie District, Northwest Territories. Somewhat later it was discovered that many buffalo began to cross Peace River to winter on an abundance of herbage to be found about Baril and Egg lakes and along the north shore of Lake Claire. In 1926 the boundaries of the park were extended south of the Peace to embrace an additional 6,800 square miles to include these new feeding grounds.

In the meanwhile the Government's experiment in preserving the plains bison at Wainwright National Park was so successful that the resources of that range were taxed beyond normal capacity. It was decided then to release a certain surplus of these animals in Wood Buffalo Park. Shipments of the Wainwright plains bison began in 1925 and were continued for four years. In this time 6,673 buffalo were liberated in the park at several points on Slave River south of Fitzgerald; this number comprised 4,826 yearlings, 1,515 two-year olds and 332 three-year olds; the majority of the animals were females.

After a period of acclimatization and general adjustment, the young bison began responding in a favorable manner to the northern environment and a definite, encouraging increase in the herds was observed. As a result of the totally wild conditions under which they live, with an abundance of luxurious vegetation and sheltering, primitive forest, it naturally follows that these transfers should become increasingly darker and more massive. In this respect, as is the case with the wood bison, they are undoubtedly developing a superiority in vitality and appearance in comparison with bison of more southern localities. The adult population at present is in splendid condition, while the calves impart an undisputed impression of being healthy, high-spirited and robust. Extensive data indicate an annual increase of not less than ten per cent. Many difficulties hamper an approximately accurate estimate of the number of bison in the park, but the results of two year's investigations placed the total at about 12,000 individuals.

By far the greater number of bison have distinct seasonal movements actuated by food conditions. During the winter months the herds invade the great grass plains, prairies, and open muskegs that lie immediately west of Slave River. These occur chiefly from a point west of Fort Smith to Peace River. Of recent years the herds also resort to extensive grass flats between Peace River and Claire and Baril lakes, as well as the Egg Lakes sector east of Chenal des Quatre Fourches. The total winter grazing area in this eastern section of the park embraces about 1,220 square miles. Of this the herds concentrate principally on the more attractive areas approximating 720 square miles.

With the approach of spring when the grassy, lowland plains begin to thaw and flood with snow water, the herds move methodically westward to the gently rolling uplands of the central area—that is, to the Alberta Plateau. This terrain rises gently westward, for the most part, from Slave River to Caribou Mountain and Buffalo Lake, and includes the whole northern area of the park. The eastern side of the plateau is comparatively dry and rolling with extensive forests of spruce, poplar, and pine; the western portion is swampy, with innumerable lakes. The greater proportion of the bison that spend the winter in the Slave River plains are distributed during the summer in the eastern part of these central uplands. This comprises an area of approximately 2,000 square miles. Summer distribution, however, is quite irregular. Some localities have few or no buffaloes as comparatively large scattered sections are low and swampy and unfit for grazing. In other places again, the animals are massed, so to speak, in favorable localities where superior forage is the chief attraction. The area notable for this occurs in the general vicinity of the trunk trails south of Pine Lake, thence northward to Grassy Slough and Flatgrass Lake. A pronounced tongue of occupation extends northward in the highlands of Salt Mountain to Sass River in the east and, farther west, in sandy and black soil uplands to the Nyarling River. A remarkable summer population also occupies the upland range from Flatgrass Lake into the eastern scarp extension, which lies in the bend of Salt River in latitude 59° 45′. For a full account of the Wood Buffalo Park bison, the reader is referred to my monograph on the the subject published in 1941.

LITERATURE CITED

ANTHONY, H. E. 1928. Field book of North American mammals. New York, pp. xxv + 625.

ELTON, CHARLES S. 1933. The Canadian snowshoe rabbit inquiry, 1931-32. Can. Field-Nat., vol. 47, no. 4, pp. 64-69 and no. 5, pp. 84-86.

GRAHAM, MAXWELL. 1923. Canada's wild buffalo. Dept. of Interior, Can., N.W.T. and Yukon Br., Ottawa, pp. 1-12.

HARPER, FRANCIS. 1932. Mammals of the Athabaska and Great Slave Lakes region. Jour. Mamm., vol. 13, no. 1, pp. 19-36.

HEWITT, C. G. 1921. The conservation of the wild life of Canada. New York, pp. xx + 344.

KITTO, F. H. 1924. The survival of the American bison in Canada. Geog. Jour., vol. 63, pp. 431-437.

MacFarlane, R. 1905. Notes on mammals collected and observed in the northern Mackenzie River district, Northwest Territories of Canada, with remarks on explorers and explorations of the far north. Proc. U. S. Nat. Mus., vol. 28, pp. 673–704.

Miller, G. S., Jr. 1924. List of North American Recent mammals, 1923. Bull. U. S. Nat. Mus., no. 128, pp. xvi + 673.

Preble, Edward A. 1908. A biological investigation of the Athabaska-Mackenzie region U. S. Dept. Agric., Bur. Biol. Surv., N. Amer. Fauna, no. 27, pp. 574.

Raup, H. M. 1933. Range conditions in the Wood Buffalo Park of Western Canada with notes on the history of the wood bison. Am. Comm. for Internat. Wild Life Protection, vol. 1, no. 2, pp. 52.

Seibert, F. V. 1923. A reconnaissance in the home of the wood buffalo. Appendix in "Canada's wild buffalo" by Maxwell Graham, pp. 13–17. Department of Interior, Ottawa.

——— 1925. Some notes on Canada's so-called wood buffalo. Can. Field-Nat., vol. 39, pp. 204–206.

Seton, Ernest T. 1911. List of mammals of the expedition in "The Arctic Prairies." New York, pp. xvi + 415.

Soper, J. Dewey. 1937. Notes on the beavers of Wood Buffalo Park, Alberta. Jour. Mamm., vol. 18, no. 1, pp. 1–13.

——— 1939. Wood Buffalo Park: Notes on the physical geography of the park and its vicinity. Geog. Rev., vol. 29, no. 3, pp. 383–399.

——— 1941. History, range and home life on the northern bison. Ecol. Monographs, vol. 11, no. 4, pp. 349–412, 19 figs.

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HABITS OF THE LEAST WEASEL (*MUSTELA RIXOSA*) IN NORTHEASTERN IOWA

By Emmett B. Polderboer

The least weasel (*Mustela rixosa*) has until recently been considered to be extremely rare, if present, in Iowa. Scott (1939) reported its occurrence in the northern and southern extremes of the state, Paul L. Errington having found two skulls in great horned owl pellets from Wapello and Winnebago counties. Polderboer, Kuhn, and Hendrickson (1941) found this species present as an item of prey in the cache of a long-tailed weasel in Story County, Iowa.

The writer has been aware of the presence of this species in the state since 1927. In December of that year two specimens taken in Albion Township, Butler County, were examined at Parkersburg, Iowa, where E. G. Kothe had them in a fur collection. On December 9, 1928, the writer trailed and subsequently trapped an adult male least weasel in Fairfield Township, Grundy County. Other trails, believed to be those of this species, were also found on the same section of land on that date. Another specimen was captured by the writer and George Synder of Randalia, Iowa, at the outskirts of that town in Center Township, Fayette County, on December 18, 1937. The trails of these weasels were fairly abundant in the vicinity of Cedar Falls, Blackhawk County, Iowa, when the writer trapped for larger fur bearers in that locality during the

winter of 1938. One specimen in the possession of Dr. Roy L. Abbott, Iowa State Teachers' College, Cedar Falls, was killed in that vicinity in January, 1939, and examined by the writer. Tracks that conformed to the size and range of the least weasel were also seen, in December, 1939, in clover meadows at Lansing, Allamakee County, Iowa. These data seem to indicate that this species is found generally distributed over the northeastern part of the state.

From December 20, 1939, to January 2, 1940, an investigation of weasel abundance and habits was conducted on the writer's home farm in Butler County. The farm is located in the northeastern corner of Section 17, Beaver Township, and consists of 144 acres. This region was glaciated by the Iowan glacier and is well drained. In the native state the area had five swales, draining away from its center, which were once overgrown with marsh grasses (*Spartina sp.*). Since 1926 the entire area has been drained by tile and subjected to alternate pasturage and cropping. No rock piles, junk piles, or other artificial refuges were present on the area. Fence-row growth was mostly timothy, blue grass, and lesser ragweed. Tall grasses were lacking on the area with the exception of a quarter acre of abandoned school grounds on the northeast corner of the tract. Cover on the area consisted of 60 acres of cornstalks, 41 acres of plowed ground, 10 acres of second-growth red clover, 20 acres of pasture, $\frac{1}{4}$ acre school ground, $\frac{3}{4}$ acre roadway, and 5 acres of farmstead and grove.

Three days were spent in thoroughly checking the area by inventory strips spaced at 5 rod intervals. The trails and dens of four least weasels and one long-tailed weasel (*Mustela frenata*) were located. Identity of the specimens was established by trapping all of the weasels at their dens with steel traps. Three of the least weasels, all adult males in fair condition, were placed in the Iowa State College museum collection at Ames, Iowa. The fourth was mutilated by shrews (*Blarina brevicauda*) to such an extent that it could not be used in the museum collection as a specimen skin.

The maximum home range of each of the four least weasels was approximately two acres. The greatest distance traveled from the center of their home ranges seldom exceeded 10 rods. Three of the least weasels lived in fence rows and denned in mole (*Scalopus aquaticus*) runs. The fourth occupied a pocket gopher (*Geomys bursarius*) burrow that was entered through small holes connecting with the burrow. One weasel foraged considerably in plowed ground at the edge of a clover field. All of them seemed to enter holes of one inch or less in diameter to the exclusion of larger holes of ground squirrels (*Citellus franklini* and *C. tridecemlineatus*) in their territories.

Examination of three den sites revealed nests of blue grass in two instances and corn silk and husk fragments in the third. Each of the nests appeared to have been made originally by mice. With the exception of small bits of harvest mouse (*Reithrodontomys*) and Baird mouse (*Peromyscus*) fur in two of the nests, no animal debris or caches of food were found such as one usually finds associated with long-tailed weasel dens. The dens were six inches below the surface in cavities four inches in cross section. No latrines, either subterranean or at the entrance of the den, were found.

Comprehensive analyses of food habits could not be determined for the specimens taken. The stomachs and intestines of all four least weasels were examined and all were empty except one, which contained a small bone fragment and a few hairs of a Baird mouse in the small intestine. A dead mole (*Scalopus aquaticus*) was found at the entrance of a burrow used by one of the weasels but there was no apparent evidence that it was a weasel kill. Two of the weasels lived within 40 rods of one another, the two others lived within 60 rods of one another, and the range of one of these was overlapped by that of a long-tailed weasel.

LITERATURE CITED

POLDERBOER, EMMETT B., KUHN, LEE W., and HENDRICKSON, GEORGE O. 1941. Winter and spring habits of weasels in central Iowa. Jour. Wildlife Management, vol. 5, no. 1, pp. 115–119.

SCOTT, THOMAS G. 1939. Noteworthy, additions to the collection of mammals from Iowa in 1938. Iowa State College Jour. Science, vol. 13, no. 3, pp. 239–241.

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ECOLOGY OF THE OPOSSUM IN EASTERN TEXAS

BY DANIEL W. LAY

The opossum (*Didelphis virginiana* L.) has received much intensive laboratory study but little has been published on its ecology as the most numerous fur animal in the southern forests. The low pelt and sport value of individual opossums may justify this neglect in management programs for limited areas, but the wide distribution and general use of opossums for fur and food calls for more consideration of the species in state-wide programs. The present paper is a summary of field observations on opossums made in eastern Texas between June 1938 and September 1940.

The more intensive data were obtained on an 86-acre live-trapping plot in an undisturbed part of Tyrrell Park, 5 miles southwest of Beaumont, Jefferson County, where 278 captures were made of 117 individuals. Through cooperation of the National Parks Service, two Civilian Conservation Corps enrollees with special interest in wildlife attended the traps that were operated almost continuously for two years. The work was supervised by frequent (weekly to bimonthly) inspections of records and trapline. A duplicate set of records was kept by me and these were brought up-to-date at each inspection. Records kept were the simple and obvious facts of appearance at trap stations, sex, number of young in pouch, presence or absence of external parasites, and general description of physical features. Further details were not required and no pressure was exerted to stimulate catches. The wildlife trapping job was considered a choice position among enrollees and inaccuracy of detail was understood to mean the substitution of a new man from the waiting list. With these precautions there remained a minimum chance for error.

Traps used were of the Biological Survey house-cat-trap design; the first six of wood were less durable (because of damp weather and wood rat damage) than the 20 metal ones that were added to the trapline later. Baits consisted of fermented fish scents and the more satisfactory fresh meat scraps. Dry corn and various fresh vegetables were tried without success. The scarcity of fresh meat scraps seriously limited catches occasionally.

Animals were marked by several methods. The first trial was of ear punches made with a baby-chick toe punch. These holes were not permanent as the cartilage refilled them in a few months or they were ripped out. Toe clipping on the two fore feet was the most permanent method of marking found and proved useful up to the number 99. The toes healed quickly and no more than two were removed from a foot. Circular ear brads were used in conjunction with toe clipping on the majority of the animals marked, but these occasionally were lost.

The trapping plot was of the poorly drained coastal pine-hardwood type, undisturbed by timber cutting for twenty years. In addition to the common trees such as loblolly pine (*Pinus taeda*), water oak (*Quercus nigra*), red oak (*Q. rubrum*), red maple (*Acer rubra*), and sweetgum (*Liquidambar styraciflua*), the fertile Lake Charles clay loam soil supported a luxuriant understory of fruiting vines and shrubs, particularly: blackberry (*Rubus flagellaris*), mayhaw (*Crataegus* sp.), bluehaw (*C. brachyantha*), blackhaw (*Viburnum molle* and *V. rufidulum*), French mulberry (*Callicarpa americana*), grape (*Vitis* sp.) and rattan (*Berchemia scandens*). The area had a more abundant and varied food supply for opossums than most of the pine woodland on sandy soils, but there were certain other factors definitely limiting its carrying capacity for opossums. One was the scarcity of water during dry periods. The animals seemed to move about considerably during droughts, leaving the area for surface water several hundred yards distant. During rainy seasons all ground dens were flooded causing a reduction of den supplies.

HOME RANGE

Of the 117 individual opossums marked during the two-year period, 58 or 49 percent were taken only once (Table 1). Twenty-two were taken only twice and 31 were taken three or more times. Of the 31, only 29 visited three or more stations thus providing a basis for mapping home ranges. Of the 29 home ranges the records are most complete for no. 19, taken 48 times at 11 stations; no. 14, taken 30 times at 13 stations; and no. 29 taken 20 times at 7 stations (see figs. 1, 2, and 3.).

The minimum home range indicated by the records was measured by connecting the outlying stations visited. The mean minimum home range, thus measured, was 11.5 acres, but the range among the 29 records was considerable (from about $\frac{1}{3}$ acre to 58 acres). The record of no. 19, which shows the greatest home range, suggests that for any one period of weeks the home range was much nearer 11.5 acres than 58 acres. After the first two visits to the traps, this female

settled down in the vicinity of stations 7 and 26, which are 400 feet apart, and made 17 repeat visits to the two stations.

The mean of the greatest distances traveled between trapping stations was 1,460 feet. This is a mean travel radius of 730 feet, which would form a theoretical, circular range of 38.4 acres. Since the record for no. 44, which forms the most complete and symmetrical range, gives an area of 39 acres, it is perhaps true that the average opossum's normal range falls between 11.5 and 38.4 acres. During extremely dry periods when no surface water was available on the plot many of the opossums apparently moved out. This abnormal extension of range, however, cannot be considered as a part of the home range.

The ranges of individual opossums overlapped so frequently that no discernible tendency towards establishment of individual territories could be

TABLE 1.—*Frequency of catch for 117 opossums*

TIMES CAUGHT	NO. OF INDIVIDUALS	PERCENTAGE
1	58	49.6
2	22	18.8
3	13	11.1
4	8	6.8
5	5	4.3
6	1	.8
7	3	2.5
9	1	.8
14	2	1.7
16	1	.8
20	1	.8
30	1	.8
48	1	.8
	117	99.6

detected. On the contrary, tracks rarely showed that two or more opossums traveled together. Family groups seem to break up rapidly after the young cease to ride on the mother. Apparently opossums generally den and feed alone, but are tolerant to neighbors. Yeager (1936) reports that 6 of 36 opossums in day-time dens were in pairs but not of mixed sexes. I found a large male and a small female in the same den in Chambers County, February 3, 1939. There were 2 young in the pouch of the female.

The wandering habit may be more pronounced in opossums than in some species. Forty-nine percent of the individuals marked were captured only once. A few may have been trap-shy and present on the area as residents, but the evidence suggests that almost half of the population on a given area are distinctly itinerants. Seasonal food and water changes cause definite movements and may account for some of the apparent wandering. The record of no. 19 (fig. 1) shows an early wandering habit and a later more sedentary life.

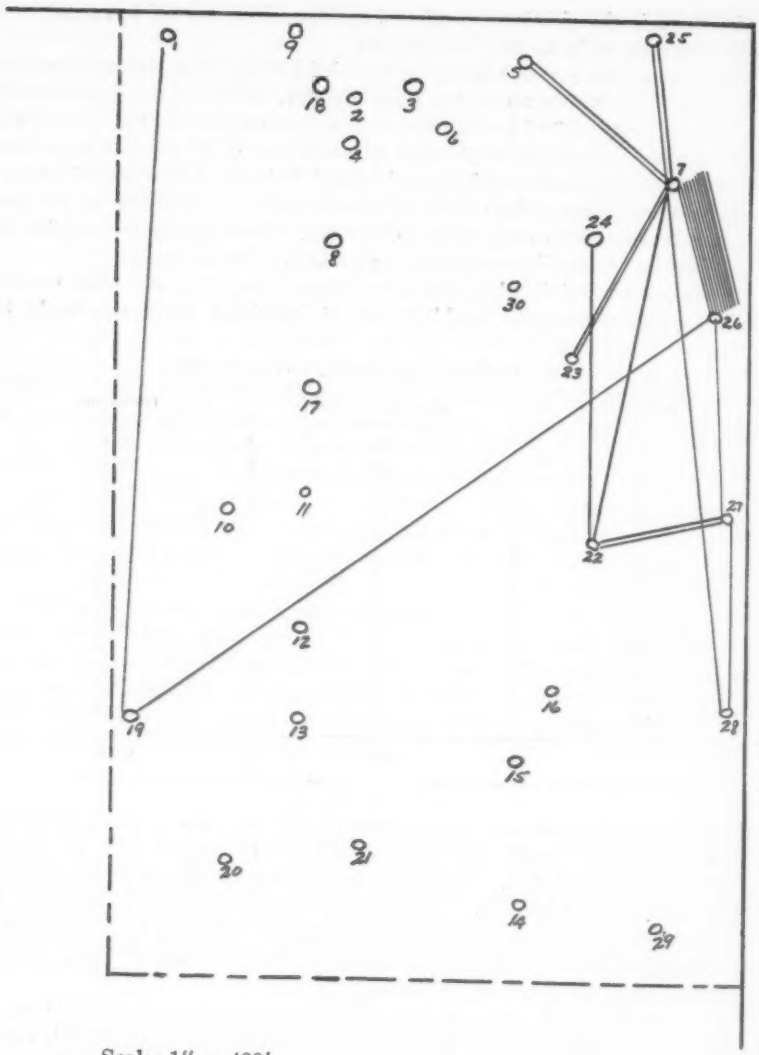
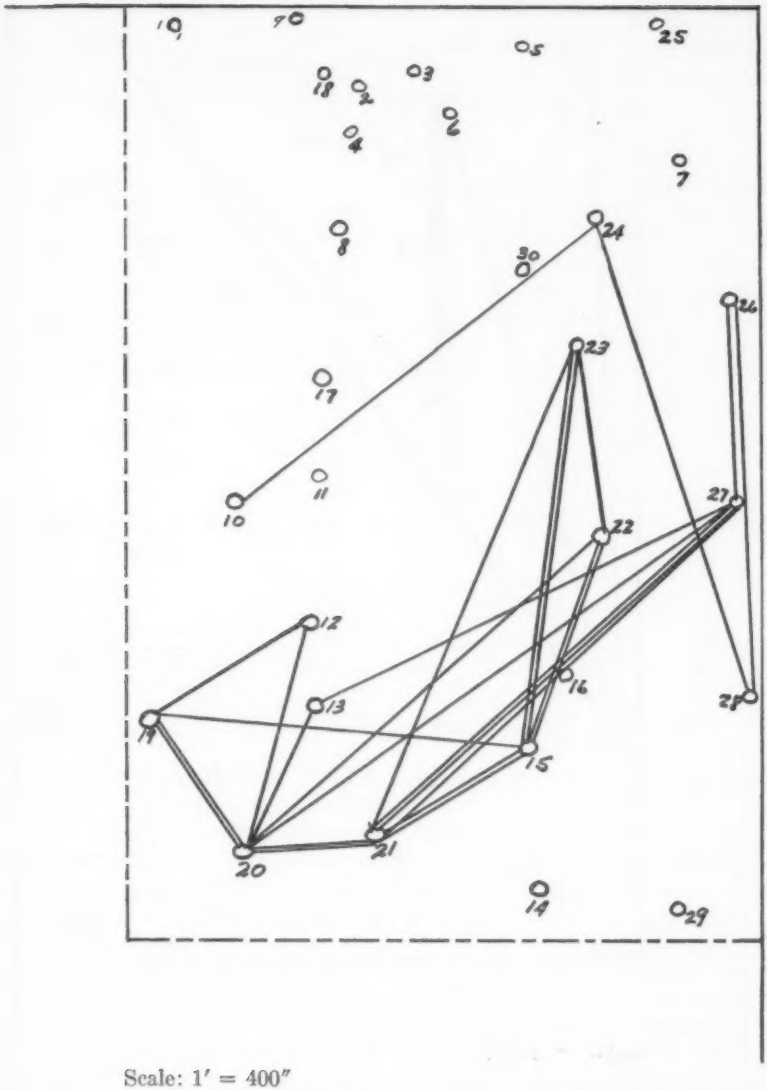
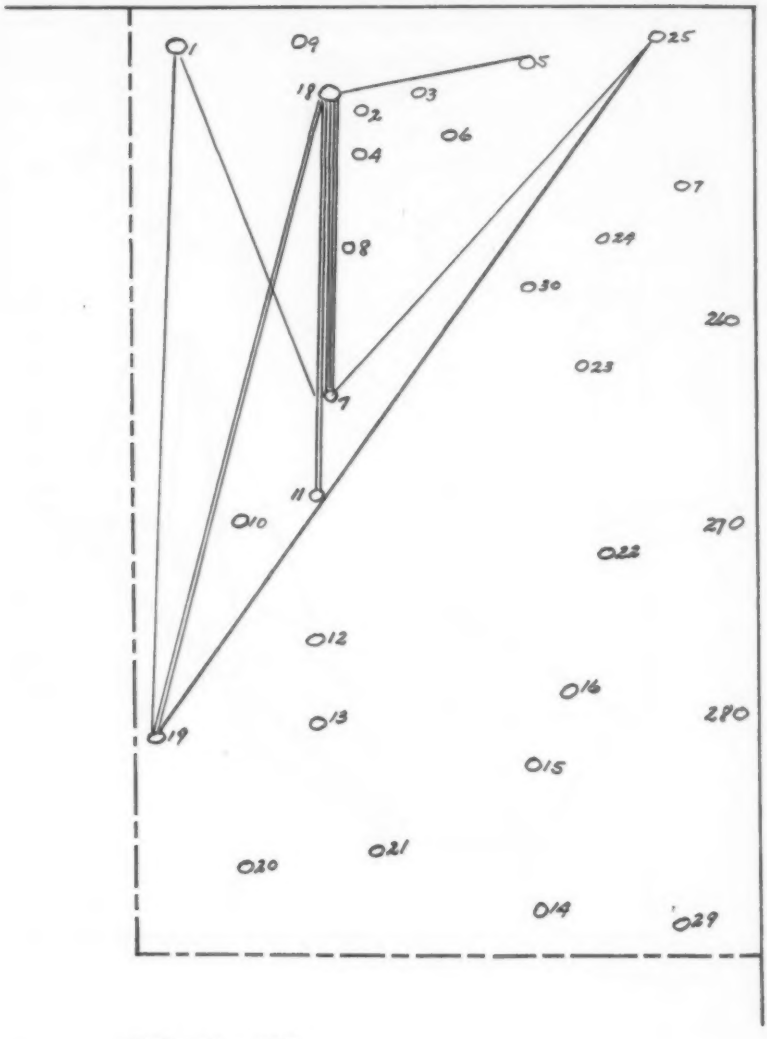


FIG. 1. Trap stations at Tyrrell Park and catch records of animal no. 19, a female, first trapped January 26, 1939, at station 1 and last trapped October 25, 1939, at station 26, taken a total of 48 times. Lines indicate assumed routes of travel between stations where taken; also, the number of known trips between such stations.



Scale: 1′ = 400″

FIG. 2. Trap stations at Tyrrell Park and catch records of animal no. 44, a female, first trapped May 31, 1939, at station 22 and last trapped March 4, 1940, at station 10, taken a total of 30 times.



Scale: 1″ = 400′

FIG. 3. Trap stations at Tyrrell Park and catch records of animal no. 29, a male, first trapped March 14, 1939, at station 18 and last trapped July 5, 1939, at station 5, taken a total of 20 times.

SEX RATIO

Among the 117 animals trapped (66 males and 51 females) the sex ratio was 57 to 43. No significant differences were found in the sex ratio between the groups retrapped one or more times and those trapped only once.

POPULATION DENSITY

The records are not complete or numerous enough to permit monthly tabulation of populations on the 86-acre study area. Table 2 is a quarterly tabulation showing an average of 21.1 (16–36) individuals trapped in each three months period. The data show an average of 12.3 animals captured only once and 8.8 taken more than once each three months period. All animals taken only once during a quarter were not transients because some were caught regularly during other quarters. Some of the quarterly periods have reduced catches due to cessation of trapping operations, lack of suitable bait supplies, or severe drought.

TABLE 2.—*Density of opossums on 86-acre plot by quarters*[1]

QUARTER	TAKEN ONCE DURING QUARTER	TAKEN MORE THAN ONCE	TOTAL
Jan.–March, 1939	11	7	18
April–June, 1939	19	17	36
July–Sept., 1939	15	9	24
Oct.–Dec., 1939	12	4	16
Jan.–March, 1940	10	7	17
April–June, 1940	11	7	18
July–Sept., 1940	8	11	19
Averages	12.3	8.8	21.1

[1] Young in pouches of females were not counted.

The records show the minimum populations and it is deduced that the actual population of opossums was probably more than one to four acres.

The average interim between the first and last dates of capture of the 56 individuals taken more than once was 83 days, which further validates the quarter year as an arbitrary basis for estimating population densities.

Trapping of 16-acre quadrats (outside the Tyrrell Park study area) with 24 no. 1½ single spring steel traps baited with a uniform fish scent produced one to four animals the first night on five plots during September and October, 1938. The use of such quadrats for population estimates was abandoned as impracticable. Catches on second and third nights suggested that few resident opossums escape the first night of trapping, but the amount of influx was a serious variable. The quadrats in Jefferson County near Tyrrell Park and in Walker County, rolling pine woodland type, each produced four opossums the first night. That the population density in favorable habitat approaches one to four acres seems more evident with this check of live-trapping results.

Walker County in 1936–37 produced an estimated crop of 5,296 opossums

pelted for fur and an additional 4,610 animals used for meat only, or a county-wide crop of one to 52 acres. The fur crop was determined by means of an interview with one fourth of the 84 licensed trappers. The meat crop was calculated from census figures of rural Negroes after the Negro Civilian Conservation Corps enrollees at the Lufkin and New Waverly camps disclosed that 57.6 percent of 2,098 Negroes living in eastern Texas eat an average of 4.9 opossums to the family a year. Only 13 percent of these animals are skinned so the pelt may be sold. Of Negro families living on farms, 76.2 percent eat an average of 5.6 opossums a year. Of those living in towns with a population of less than 10,000, 49.1 percent of the families eat an average of 3.4 opossums a year. The density of the opossum population that produces this annual county-wide harvest of one opossum to 52 acres might easily be the density of one to 4 acres indicated for favorable habitat by other observations.

Population density of opossums on 102 acres of sandy coastal prairie in Chambers and Jefferson counties in February 1939, was one to 14.6 acres. The census was made by excavation of all dens found on measured 4-acre sample plots. The prairie seems to be less productive of opossums than woodland.

LIFE SPAN

All but one of the 56 opossums having an average trapped-life span of 83 days were weaned from their mother before being trapped the first time. Some were full grown, but all, with one exception, were more than three months of age. Although traps were operated more than 24 months, the trapping span of only one individual exceeded 11 months. In consideration of the high breeding potential, a relatively short life span would be expected and the trapping data bear this out.

The most vulnerable period, other than the one at parturition when the 13-day-old opossums struggle through long hair to find a nipple in the mother's pouch, seems to be the early days after the young are weaned and leave the mother. Only one litter was marked in the Tyrrell Park study. The nine young were toe-clipped when about ready to leave the mother, no. 49, but only one of the nine was ever found again although the mother remained on the area a full year.

Opossums seem to lead a reckless life with little concern for the commonplace parasites, cuts, scratches, broken legs or tail, lost toes, ripped ears, and broken teeth. Only 5 of the 56 animals were free of ticks. Ticks found on the opossums were identified by Dr. R. A. Cooley, U. S. Public Health Service, Division of Infectious Diseases, Hamilton, Montana, as *Dermacentor variabilis*. Four of those with ticks carried fleas and two also had red bugs. The fleas were determined by William L. Jellison, U. S. Public Health Service, Division of Infectious Diseases, Hamilton, Montana, as *Rhopalopsyllus* sp., probably *gwyni*. This genus is uncommon in the United States, but is abundant in South America, according to Jellison.

Some animals with heavy infestations of ticks were fat; others with ticks attached only to the ears, or completely absent, were not in good flesh. Animal

no. 22 had numerous ticks and was fat when first caught (May); four months later she had none but was still fat. No apparent correlation between condition and presence of external parasites was found. No. 29 died in the trap after frequent visits and, although the carcass was not preserved or examined, the field notes from the trapline suggest a combination of contributing factors: "May 4, 1939 very full of ticks, poor, left ear running, rotten smell. May 5 same. May 6 slight skinned place on back and tail. May 8 same and ear still sore. May 13 same. May 15 hair almost gone, full of ticks. May 27 half through molting, toe cut. May 29 same. June 12 skinned place below eyes and on hip. June 15 full of ticks, molting, skinned on back and hip, also very bad smell. June 23, 25, 27 same. June 28 no. 5 toe ripped off, still bleeding. June 30 full of ticks, skinned place on back, no. 5 toe swollen. July 2 dead in trap." These observations by the untrained enrollees who attended the traps provide a graphic, if incomplete, description of this male opossum.

The only other opossum found dead was no. 132, an immature female reported as "sick and poor, with few ticks" on May 31, 1940, and found dead near station 20 on June 11.

BREEDING HABITS

The beginning of the opossum's breeding season has been well described by Hartman (1928). The modal point for ovulation occurs in the third week of January. The gestation period is 13 days from coitus to parturition and the postnatal period of dependence on the mother is 90 to 100 days. The Tyrrell Park live-trapping operations revealed some incomplete details of reproduction in the wild. Table 3 summarizes the monthly proportion of females with young in the pouch found between September 1938 and September 1940, both on the Tyrrell Park project and elsewhere in southeastern Texas. Only adult or subadult females were examined.

The 7-month period of January to July inclusive was the only time when young were found in the pouch. The percentage of females with young varies from the lows of 29 in January and 45 in April to peaks of 60 in February and 96 in June. The end of the period is well defined. Seventeen or 74 percent of the females examined in July carried young, whereas none of the 28 examined in August was with young. The 64 females examined between September and December were likewise without young.

Two litters a season were produced by three individual live-trapped females and in no instance did the records reveal that a female carried less than two litters during the breeding season. Hartman (1928, p. 154) states there are at least two litters of young a year in the southern states and that it seems probable that a third is produced by a small percentage of unusually fecund females. His deductions are based on weight groupings of 117 mature females and about 12 litters of pouch young after May 1, one of them in August and two in September. The present investigation substantiates Hartman's deduction of two litters being normal, but fails to disclose any evidence of a third litter.

Number 19 had nine young in her pouch on January 26, 1939. When she was

taken again on April 23 she had 10 very small offspring in the pouch, which were observed 11 times before July 12 when only one remained. On July 13 it was gone. Number 23 had 8 small young on January 26, six larger ones March 10 and five very small ones April 13. Number 24 had two young in her pouch on February 6 and 7; new ones on April 19, 1939. In September and again in October when she was retrapped there were no young in the pouch. The probability that two litters a year are normally produced is further indicated by the length of the breeding season, which is approximately double the period the young remain in the pouch or crawl on the mother, and by the presence of two peaks of breeding percentage in February and June with a low in April.

The second litters appear in the pouch from early in April to as late as May 20 to 23, according to the six records that show a definite period in which late young were born. Four of the records are for April. Allowing 90 or more days

TABLE 3.—*Opossum breeding summary*

MONTHS	FEMALES EXAMINED	NO. WITH YOUNG	PERCENT WITH YOUNG
January	7	2	29
February	10	6	60
March	10	5	50
April	11	5	45
May	22	14	64
June	28	27	96
July	23	17	74
August	28	0	0
September	32	0	0
October	11	0	0
November	11	0	0
December	10	0	0

for development before the end of July, it would be expected that most second litters would be born in April. Two of the six records, however, are of litters born about May 1 and between May 20 and 23.

Sixty-five litters averaged 6.8 individuals. The January to March litters were 6.4 as compared with the May to July litters of 6.9. The difference is not statistically significant, although it is interesting that the more abundant supply of spring fruits coincides with the period of larger litters.

FOOD HABITS

The species has little trouble finding food because a great range of substances is acceptable. All of 16 stomachs taken in September 1938 were more than half full. Volume estimates of the contents of these stomachs were: Insects and worms, 45 percent; fruit, 11.8 percent; green leaves, 11 percent; trash (leaf and log litter), 10.6 percent; mammals, 7 percent; acorns, 4.7 percent; birds, 4.3 percent; crayfish, 3.3 per cent; snails, 0.75 percent; grass seeds and cellophane, traces. The fruits included French mulberry and grape. At other

seasons blackberry, bluehaw, and persimmon fruits have been noted as opossum foods. The limiting effects of food supply could rarely be operative on the opossum.

DENS AND ASSOCIATES

In the den census of 102 acres of prairie the ratio of other animals to one opossum was 1.43 armadillos, 1.14 striped skunks, 0.29 spotted skunks, and 0.14 mink. For every occupied den there were four empty dens and two blind traps or short holes. Distribution of opossum dens on the census areas showed a rather close correlation with woody cover in the form of wax myrtle bushes and blackberry. Although two of the opossums were found in dens not protected by any woody cover, five others were located under the roots of small bushes.

The seven opossum dens excavated in the prairie den census indicated something of the relationship of opossums to armadillos. One large male opossum was with a male armadillo in a den characteristic of armadillo workmanship. A bushel or more of old nest material and fresh soil was piled immediately before the entrance to the den. Two side burrows led away from the nest material in the central chamber. Both of these features are commonly found in armadillo dens. Another opossum, a female with 8 young, was found in a minor part of a network of armadillo excavations. The other five opossum dens showed little if any indication of armadillo use. The typical opossum den on the prairie is a simple burrow about 6 feet long, without branches and without the pile of soil at the entrance that characterizes the typical armadillo burrow.

The importance of armadillo burrows for fur animal dens is problematical. It is true that opossums use armadillo burrows and it is likely that they dig few dens. But opossums were common before the armadillo migrated into the region and there is an abundance of unoccupied dens on the prairie that were made by skunks or other agents. This surplus of available den sites on the prairie as well as in woodland makes it unlikely that den sites are limiting factors for opossums.

A series of 30 artificial den boxes made of 8-inch boards was planted in 1938 in prairie at a distance from woody cover and in woodland. Two of the ten boxes in prairie were used, one by a common skunk and one by an opossum. The 28 boxes not used further indicate that den sites are not a serious limiting factor.

OPOSSUM AS FUR RESOURCE

The available records in Texas on the number of fur pelts handled are incomplete. Lay (1938 and 1939) has discussed these records. The state-wide crop in all probability exceeds one million opossums a year. When the pelt value is 25 or 30 cents each, the trappers in more favorable habitat make a satisfactory income because of the large number of opossums and the relative ease of skinning and stretching their pelts. The opossum is doubtless the most numerous fur animal in Texas, but the value of the annual catch probably is exceeded by the catch of muskrats.

DISCUSSION

Neither food supplies nor den supplies appear to limit opossum populations as much as man's fur trapping, predatory animal control, and meat hunting. There is a tremendous waste of opossums when the meat or fur is either of poor quality or is not desired. The fur is generally prime only between December 15 and January 15 in Texas. Concentration of predatory animal trapping in winter would prevent loss of fur value and (with the larger traps) springs under the pans would reduce captures of unwanted opossums.

SUMMARY

1. Live-trapping in 86 acres of flat coastal pine-hardwood with 26 traps for 24 months revealed 117 opossums, which were taken 378 times.

2. Fifty-eight or 49 percent of them were taken only once and 29 individuals visited three or more stations. The average minimum area between the stations in these 29 home ranges was 11.5 acres. The mean of the greatest distances traveled between stations was 1,460 feet, which would form a theoretical circle of 38.4 acres.

3. Separate individual territories are not important to opossums as home ranges overlapped in every instance.

4. The sex ratio among 117 opossums trapped was 57 males to 43 females.

5. A population density of one to four acres was estimated for the 86-acre study plot on the basis of quarterly tabulations of catches.

6. An annual county-wide harvest of Walker County of one to 52 acres was revealed.

7. A trapping-life-span of 83 days and the rapid disappearance of young after weaning suggests a relatively short life cycle for opossums.

8. Two litters a year are normal during the January to July breeding season. Three case records of two litters per female were revealed by live trapping. Peaks of breeding are reached in February and June with a low in April. None of the 92 adult females examined July 31 to December 31 carried young in the pouch. The mean of 65 litters was 6.8 young.

9. Food supplies rarely could limit opossum populations because almost any vegetable or animal food is acceptable, as indicated by inspection of 16 stomachs and other observations.

10. Dens are not limiting factors; and armadillos, although useful, probably do not cause increases in opossum numbers.

11. The Texas opossum crop exceeds one million pelts a year, but in value the opossum is probably second to the muskrat.

12. No intensive habitat improvement for the opossum can be justified economically, but various measures for preventing waste of opossums should cause some increase in the total population.

LITERATURE CITED

HARTMAN, CARL G. 1928. The breeding season of the opossum (*Didelphis virginiana*) and the rate of intra-uterine and postnatal development. Jour. Morph. and Phys., vol. 46, no. 1, pp. 143–215.

LAY, DAN W. 1938. Opossum status studied. Mo. Bull., vol. 2, no. 1, Tex. Game, Fish and Oyster Comm., Austin.

——— 1939. Fur resources of eastern Texas. Bull. no. 15, Tex. Game, Fish and Oyster Comm., Austin.

YEAGER, LEE E. 1936. Winter daytime dens of opossums. Jour. Mamm., vol. 17, no. 4, pp. 410–411.

Game, Fish and Oyster Commission, Austin, Texas.

ON THE CAUSE AND NATURE OF A POISONOUS ACTION PRODUCED BY THE BITE OF A SHREW (*BLARINA BREVICAUDA*)

BY OLIVER P. PEARSON

A number of years ago it was common knowledge that the bite of a shrew was poisonous and, in England and on the Continent, these little mammals of the insectivore group were feared as much as the viper. The attitude of 17th century naturalists toward the shrew is illustrated by the following quotation from a book entitled "History of the Four-footed Beasts and Serpents" by the Reverend Topsell published in London in 1658: "It is a ravening beast, feigning itself gentle and tame, but, being touched, it biteth deep, and poysoneth deadly."

With the passage of time, confidence in the poisonous powers of the shrew seems to have waned, especially among those educated in science, until today this strange power is relegated to the category of quaint folklore. It is possible that this change in outlook has been brought about by the discovery of bacteria and their power to cause serious infection of small wounds. When learned people of our day encounter the statement that the bite of a shrew is poisonous, they pass off the matter by stating that our unfortunate ancestors knew nothing of asepsis and did not suspect that the teeth of animals were teeming with bacteria capable of causing an infection that might result in death.

In 1889 Maynard reported the effects produced by a short-tailed shrew that bit him when he was trying to capture it. The skin of his hand was barely punctured in a number of places, yet within 30 seconds a burning sensation was felt, which soon became intensified by shooting pains in the arm. The pain and swelling reached a maximum in about one hour, but considerable discomfort was felt for more than a week afterward.

The rapidity with which the effects of this bite were felt makes it certain that something other than bacterial infection was involved. Maynard passed off the incident by stating that an enraged animal, even a man, is capable of inflicting a poisonous wound.

Some time after I had read Maynard's paper, Dr. George Wislocki called my attention to the fact that the submaxillary salivary glands of *Blarina*, the short-tailed shrew, contain an unusual segment of coarsely granular cells in the secretory tubules, a type of segment that to my knowledge has been found in no other mammal except *Crossopus fodiens*, an European water shrew (Schaffer, 1908).

The discovery of this peculiar characteristic of the submaxillary gland suggested at once that it might be the seat of production of some poisonous sub-

stance. A knowledge that the poison glands of reptiles were merely modified salivary glands made this idea seem even more plausible. Since shrews sometimes kill and feed upon mice considerably larger than themselves, it also seemed reasonable to suppose that some kind of venom would be of assistance in securing such food.

To test this theory, shrews were put into the same cage with white mice (*Mus*) and meadow mice (*Microtus*) and allowed to bite them; the animals were then separated before any serious wounds were inflicted. Although the actual amount of tissue cut by the shrews' teeth was slight, in a number of cases the mice were seriously affected and remained huddled in one corner of the cage in a depressed state for some time. The effect on the mice was great enough to indicate that some toxic substance was actually produced by the shrews.

INJECTIONS INTO MICE

To control the experiments more accurately and to locate definitely the source of the poison, the submaxillary and parotid salivary glands were removed from a *Blarina* and ground with sand in 0.9 percent sodium chloride solution; one cc of this solution was used to each 0.1 gram of tissue. As a control the spleen was treated similarly. The fluids obtained from these tissues in this manner were then injected subcutaneously or intraperitoneally into white mice and the effects were noted.

Those mice injected with extracts of parotid salivary glands and the spleen showed no ill effects whatsoever, whereas those injected with extract of the submaxillary glands were affected almost immediately. Within one minute after the injection the mice usually exhibited uncontrolled twitching movements of the body and gave evidence of apparent irritation of the region injected. When intraperitoneal injections were used this resulted in a dragging and squirming of the hindquarters, sometimes accompanied by ill-directed attempts at scratching with the hind feet. These symptoms were followed immediately by a marked slowing of the respiratory rate and a generally depressed condition. The mice preferred to sit quietly with half-closed eyes, not responding readily to stimuli; the breathing was labored. In a short time the hind legs lost their power to support the body and locomotion was accomplished with difficulty. If a sufficient dose of extract had been given, the condition of the animal grew steadily worse, the eyes became dark in color and presently began to protrude, and a short time thereafter the animal had convulsions and died. Death was due primarily to respiratory failure.

Intraperitoneal injection of extract of 2.9 mg of fresh submaxillary tissue to each 20 grams of body weight resulted in death in more than half the mice tested. Extract of 5.7 mg produced death in five cases out of six, and all injections of extract of more than 11 mg resulted in the death of the mouse.

Subcutaneous injections required a somewhat larger amount of extract to produce lethal effects, and caused a marked local reaction that did not occur when the toxic material was administered intraperitoneally. This reaction is characterized by considerable inflammation of the skin near the point of injection, and a subcutaneous accumulation of clear fluid.

Intravenous injection of the material into mice was considerably more effective than either intraperitoneal or subcutaneous injection. A dose as small as the extract of 0.3 mg to each 20 grams of body weight was found to be lethal in some cases, and five of eight mice injected intravenously with 0.4 mg per 20 grams of body weight died within 3 to 19 minutes. The submaxillary glands of a single

TABLE 1.—*Effect of extracts of the submaxillary glands of Blarina injected into white mice*

DOSE INJECTED		NO. OF MICE INJECTED	NO. OF MICE		TIME OF DEATH AFTER INJECT
Total mg	mg/20 gm		Killed	Alive	
Intraperitoneal injection					
10	15.4	3	3	0	30–56 minutes
8.4–10	11.4	4	4	0	17–57 "
4.1–5	5.7	6	5	1	21–135 "
2.4–2.6	2.5–2.9	7	4	3	15–130 "
1.25–1.35	1.4–1.5	4	0	4	
Intravenous injection					
0.9–1.0	1.26	3	3	0	2–6 "
0.52–0.63	0.75	8	8	0	2–20 "
0.41–0.5	0.56	8	4	4	3–25 "
0.32–0.36	0.42–0.45	8	5	3	3–19 "
0.21–0.26	0.27–0.29	9	2	7	7–15 "

Blarina will supply more than 200 doses of this size. The more rapid death produced by intravenous injection is characterized by labored breathing, protruding eyes, and convulsions.

INJECTIONS INTO RABBITS

A number of experiments were performed in which the poison was injected into a vein in the ear of intact laboratory rabbits without anesthesia. The protocol of one of these experiments, recorded by Dr. Krayer, is reproduced below:

EXPERIMENT 2.—*Rabbit. Male. 1.35 kgm.*

TIME	SIZE OF PUPIL	RESP./MIN.	REMARKS
6:05	large	320	
6:07	very small	60	Injected 10 mg. submax. Animal walking stiffly
6:09		56	Animal lying flat. Urination; convulsion
6:10	larger		Respirations gasping, lying on side
6:11	large		Animal dead
6:14	constricting		

Autopsy: Right ventricle dilated; left ventricle small; left auricle markedly distended; right auricle somewhat distended; lungs full of blood, and bright red; on cutting, blood flows out and the surfaces of the lungs show disseminated hemorrhages.

In this experiment it may be seen that the animal succumbed in less than five minutes to a dose amounting to extract of only 7 mg of fresh tissue per kilogram of body weight. The extract of 3.3 mg per kilogram injected into another rabbit produced a very marked effect similar to that recorded above, but the animal recovered. In a control experiment the injection of extract of 16 mg of parotid gland tissue per kilogram of body weight produced no significant effects.

ACTION UPON CIRCULATION AND RESPIRATION

To study more closely the effects this poison has on the organism, a rabbit under urethane anesthesia was prepared to permit record of blood pressure, heart beat, and rate and depth of respiration upon a moving paper while injections of the salivary gland extracts were made into the femoral vein. Extract

TABLE 2.—*Injection of extracts in 2.7 kg rabbit*
(Urethane anesthesia 1.4 grams/kg.)

TIME IN MIN. FROM START	BLOOD PRESSURE IN MM HG.	HEART RATE PER MIN.	RESP. RATE PER MIN.	REMARKS
0	75	225	255[1]	
1				Injected extract of 20 mg parotid gland
2	78	222	245	
4	76	230	240	
4½				Injected extract of 20 mg submaxillary gland
4¼	38	168	276	
6	60	192	114	
12	70	222	40	Respiration gasping
22	80	138	39	Respiration gasping and shallow
30	75	138	42	Pupils of eyes narrow. Blood becomes dark
37	50	208	42	Pupils of eyes begin to dilate
39	36	216	30	Respiration shallow and irregular
40	18	162	12	Respiration stops periodically
41				Animal dead

[1] The respiration rate at the beginning of the experiment was very high because of high room temperature.

of 20 mg of parotid gland produced no effect on respiration and only a slight effect on circulation. An intravenous injection of extract of 20 mg of submaxillary gland caused an almost immediate increase in the depth and rate of respiration, followed within three minutes by a decrease in rate to one quarter that of normal. Injection of the poison in some cases is followed by an immediate cessation of breathing for a number of seconds. The effects upon respiration produced by the 20 mg injection, together with the effects upon the circulatory system, are summarized in Table 2.

It may be seen that the blood pressure fell off sharply immediately following the administration of the poisonous extract and there was a marked slowing of the heart. Blood pressure then returned slowly to normal and the heart rate improved considerably, but a secondary reaction soon became apparent and the blood pressure began to decline again. The heart became progressively weaker and finally failed. Upon autopsy the auricles were still beating.

The action of the poisonous substance on the respiration and circulation of the cat has also been recorded. Extract of 60 mg of parotid gland tissue injected into the femoral vein of a 3 kgm cat under chloralose anesthesia gave only a transitory effect on the blood pressure and no effect on the respiration. Extract of 20 mg of submaxillary tissue, however, caused an almost immediate disruption of the regularity of the breathing, followed by a marked slowing of the rate of respiration similar to that demonstrated in the rabbit. A profound effect on the circulation was also produced. There was an immediate drop in blood pressure accompanied by a marked slowing of the heart, followed by a secondary increase in blood pressure to a level greater than normal, then a slow settling to the normal pressure. The return to normal conditions occurred about 15 minutes after the injection.

Injection of extract of 6.7 mg of submaxillary tissue produced similar effects, although the reaction was not so pronounced. After recovery another injection of extract of 20 mg of submaxillary tissue was made, which produced effects upon the blood pressure similar to those recorded above, but the decrease in heart rate did not occur, the blood pressure returned more quickly to normal, and the secondary increase above the normal level was more pronounced. After recovery from this dose had progressed for about five minutes, it became apparent that the animal was experiencing considerable respiratory difficulty. The regular breathing was interrupted frequently by gasps for breath, a situation that became steadily more acute. Sixteen minutes after the injection the heart beat suddenly became highly irregular, while the respiration became very slow and even more gasping in nature. Twenty-seven minutes after the injection, in an effort to save the animal, one mg of atropine sulfate was injected, but the cat died almost immediately.

A complete analysis of the effect of the extract upon respiration and circulation can only be made when chemical investigation of the extracts has led to the isolation of purified material.

PROPERTIES OF THE TOXIC EXTRACT

The fluid obtained after grinding the fresh submaxillary tissue in salt solution may be heated at 100°C. for ten minutes and the coagulated material filtered off, without destroying the activity of the extract. There is, however, some loss of activity due to this treatment. Heating at 100°C. for ten minutes at pH 10 abolishes the poisonous effects, while similar treatment at pH 2 reduces, but does not abolish the activity of the extract. The toxic material is soluble in water and salt solution but not in acetone, and it does not seem to be destroyed by drying.

THE RETROLINGUAL GLAND

There are three major pairs of salivary glands in *Blarina brevicauda*: the large parotid glands posterior to the ear, the large submaxillary glands on the ventral side of the neck on either side of the midline just beneath the skin, and a small retrolingual gland closely appressed to the anterior end of each submaxillary gland. Evidence has been obtained indicating that the retrolingual gland also

contains a toxic material capable of causing death when injected into mice. Extract of 30 mg of tissue injected intraperitoneally caused the death of a 16 gram mouse in 57 minutes. Twenty mg intravenous injections in the cat and rabbit caused a reaction similar to that produced by submaxillary extract, but of less serious proportions. The retrolingual glands are so small that it is difficult to obtain sufficient material for extensive tests and the possibility of contamination from the adjacent submaxillary glands has not been entirely eliminated.

SALIVARY GLANDS OF OTHER MAMMALS

To eliminate the possibility that the submaxillary tissue of many different mammals might be poisonous, the glands from the following species were treated in a manner similar to that described for *Blarina* and tested for toxicity on white mice: *Sorex personatus*, long-tailed shrew; *Scalopus aquaticus*, common mole; *Peromyscus leucopus*, white-footed mouse; *Microtus pennsylvanicus*, meadow mouse.

Of special interest are the results obtained with *Sorex*, since this genus includes the common shrews of England and the Continent where folklore has endowed all shrews with poisonous qualities. Owing to the small size of these glands in *Sorex*—the entire animal weighs only three grams—no attempt was made to separate the retrolingual from the submaxillary glands; both were ground up together. The parotid glands were ground separately. Intraperitoneal injections into mice were made of extract of approximately 15 and 30 mg of submaxillary-retrolingual tissue, but only a mild reaction was produced. The larger dose caused some discomfort and twitching movements, but recovery was rapid. Extract of parotid gland produced no ill effects whatsoever. *Sorex personatus* must be considered relatively innocuous, therefore, compared with *Blarina*, of whose submaxillary glands 6 mg provide a lethal dose for a mouse.

Since moles were the closest relatives of shrews available, extracts were made of the salivary glands of these animals and large doses were then injected into mice. No ill effects whatsoever were noticed.

Extracts of *Peromyscus* parotid gland and submaxillary gland caused some discomfort in the mice injected, the most noticeable symptom being labored breathing. Extracts of the salivary glands of *Microtus* produced similar effects, but in spite of large doses no mice were killed by these injections.

DISCUSSION

It seems strange that the poisonous properties of an animal as common as *Blarina* could be so long overlooked.

Of what value the possession of this poison is to the shrew is difficult to determine. The most obvious assumption is that it aids in overcoming prey such as mice. To make such a theory acceptable, it has been necessary to demonstrate that the poisonous substance obtained by grinding up the salivary glands actually finds its way into the saliva. This has been shown by obtaining samples of saliva from anesthetized shrews by means of electrical stimulation. Saliva

obtained in this way and injected into mice showed conclusively that the toxic substance was present. It is probable that the saliva secreted under actual fighting conditions is even more toxic than samples obtained by electrical stimulation, since it has been shown in larger mammals that the composition of the saliva varies considerably depending upon the stimulus used to obtain it.

Actual introduction of the saliva into a wound would be facilitated by the pair of long, lower incisor teeth. The ducts of the submaxillary glands open between these teeth near their bases, and the saliva could flow into the wound along the groove formed between the two teeth.

The basis for the early belief in Europe that shrews were poisonous is still obscure, since *Blarina* does not occur on that continent. It is possible that the European species of *Sorex* will prove to be more poisonous than the American *Sorex* which I have tested, or it is possible that the European water shrew, whose submaxillary glands are histologically similar to those of *Blarina*, will be found to possess a strong toxic substance. Popular belief could easily have extended the poisonous powers of one shrew to include all shrews.

The discovery of a primitive mammal with a poisonous bite at once suggests homology with the situation found in reptiles. The poison glands of most snakes, however, are modified parotid salivary glands whose ducts empty from the upper jaw. The parotid glands of *Blarina* are quite innocuous, since the toxic material is produced in the submaxillary glands whose ducts lead to the lower jaw. The toxic extract obtained from *Blarina*, however, appears to have some pharmacological properties similar to those of snake venoms.

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SUMMARY

1. A poisonous extract has been prepared from the submaxillary salivary glands of the shrew, *Blarina brevicauda*.

2. A toxic material is also present in the saliva and may be introduced into wounds made by the teeth.

3. The toxic effect of the extract is characterized by a local reaction, lowering of the blood pressure, slowing of the heart, and inhibition of respiration.

4. A lethal dose for a 20 gram mouse is provided by the extract of 5.7 mg of fresh submaxillary tissue when injected intraperitoneally, or of 0.4 mg by intravenous injection. The lethal dose for rabbits injected intravenously is extract of approximately 7 mg per kilogram of body weight.

5. The toxic material is soluble in water and salt solution, but not in acetone. Heating to 100° C. in neutral or acid solution does not abolish the toxic effect. Similar heating in basic solution destroys the effect.

6. Injection of large amounts of extract of the parotid salivary glands of *Blarina* produces no serious effect on mice, cats, or rabbits.

7. Salivary glands of *Sorex*, *Scalopus*, *Peromyscus*, and *Microtus* have also been tested. Slight toxic effects were noted in some cases, but not comparable to those produced by the submaxillary glands of *Blarina*.

LITERATURE CITED

MAYNARD, C. J. 1889. Singular effects produced by the bite of a short-tailed shrew, *Blarina brevicauda*. Contributions to Science, vol. 1, p. 57.

SCHAFFER, J. 1908. Zur Histologie der Unterkieferspeicheldrüsen bei Insectivoren. Zeit. f. wissenschaftliche Zoologie, vol. 89, p. 1.

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GEOGRAPHIC VARIATION IN NORTHWESTERN SNOWSHOE HARES

BY WALTER W. DALQUEST

Since E. W. Nelson's "Revision of the Rabbits of North America" was published, relatively little has appeared in print about the snowshoe hares of the western part of the United States. To be sure, the hares of British Columbia have received attention in recent years from Racey and Cowan (1935) and Cowan (1938), but little has been done towards making out the relationship of the northern hares to those immediately to the south. Reasons for this were that adequate series of specimens were lacking from important localities, and that the specimens available reposed in several widely separated collections. When all the available material was brought together, there proved to be more than three hundred snowshoe hares from British Columbia, Washington, Oregon, and Idaho, pertinent to the present study.

Individual, secondary sexual, age, and geographic variations in these mammals have made the identification of individual specimens, or even small series, difficult. The large size of snowshoe hares and their extensive geographic range make these same variations relatively easy to study when adequate material is available. I have laid special emphasis on variations in the following pages.

I am indebted to Professor Arthur Svihla, Department of Zoology, University of Washington, under whose direction this work was largely carried on. For invaluable assistance or for the loan of pertinent specimens I am grateful to Professor Trevor Kincaid, University of Washington; Dr. Hartley H. T. Jackson, United States Fish and Wildlife Service; Dr. E. Raymond Hall, Museum of Vertebrate Zoology, University of California; Dr. Victor B. Scheffer, United States Fish and Wildlife Service; Dr. Emmet T. Hooper, University of Michigan Museum of Zoology; Clifford C. Gregg, Field Museum of Natural History; Dr. Harold J. Coolidge, Museum of Comparative Zoology; Wharton Huber, Academy of Natural Sciences of Philadelphia; George E. Hudson, Charles R. Connor Museum at Washington State College; R. E. Dimick, Oregon State College; Dr. Ian McTaggert Cowan, Provincial Museum of British Columbia; Stanley G. Jewett, Portland, Oregon; Dr. Robert C. Miller, California Academy of Sciences; Alexander Walker, Tillamook, Oregon; C. Frank Brockman, Mt.

Rainier National Park; and my many friends of the Pacific Northwest Bird and Mammal Society.

METHODS

All capitalized color terms are after Ridgway (1912), and all measurements are given in millimeters.

Measurements of total length and length of hind foot were taken in the field by the collector. The collectors' measurements of length of tail and height of ear are not used. The length of tail is difficult to measure accurately, and the extreme variations recorded (sometimes more than 100 per cent in animals of otherwise equal size) make this measurement of but little value taxonomically. For many specimens the height of the ear is not given on the label, and when given it is often impossible to tell whether "height from notch" or "height from crown" is intended. When the doubtful cases were eliminated the remaining cases were too limited to be significant.

All cranial measurements were taken by the writer with a vernier caliper reading accurately to tenths of a millimeter. Cranial measurements were made as follows: Condylobasal length, from the posterior edge of the right occipital condyle to the anterior edge of the right upper incisor; interorbital breadth, least distance across the interorbital region; zygomatic breadth, measured on the outside at the point of greatest width; rostral depth, measured about 5 mm anterior to the tooth row; cranial breadth, measured just posterior to, and on a plane with, the zygomatic arches; length of tooth row, alveolar length of maxillary tooth row; length of incisive foramina, of right foramen; breadth of incisive foramina, measured at surface at the point of greatest width.

All specimens examined, unless otherwise noted, are in the collection of the California Museum of Vertebrate Zoology.

INDIVIDUAL VARIATION

Within the range of any northwestern subspecies of snowshoe hare, individual variation is only moderate. The color of the underfur is variable to a slight degree in both winter and summer pelage, especially in the former. The color of the head varies much in the race *bairdii*, and less so in other races. The size of the blackish rump patch is variable. The ground color of the upper parts is constant for a subspecies, although the appearance of the upper parts is often much altered by wear. The color of the chest-band, flanks, and underparts varies but little.

In areas of intergradation, variation in color seems to be greater than near the center of the range of a subspecies. Along the western base of the Cascade Mountains in Washington, in the area of intergradation between *washingtoni* and *cascadensis*, some extreme and unpredictable variations occur. In some winter specimens from Skykomish, Washington, there was a variation through white, as in typical *cascadensis*, to grey, light tan, dark tan (the usual winter color of *washingtoni*), to dark brown.

In non-linear cranial characters, such as crenulations of the molars, strength

of development of the orbital processes, shape of the incisive foramina, and depression of the interorbital region, no two specimens seem to be exactly alike.

A study of individual variation in external and cranial measurements was made in the race *washingtoni*. In the specimens used it was found that the coefficients of variation in the characters selected for detailed study and taxonomic use were surprisingly small. Actual variations were considerable but the curves formed by the measurements were normal.

TABLE 1.—*Individual variation in Lepus americanus washingtoni*

MEASUREMENT (IN MM)	MEAN	RANGE	MEAN DEVIATION	COEFFICIENT OF VARIATION
Total length	413	380–455	20.0	5.3
Length of hind foot	117	105–135	6.0	6.0
Condylobasal length	65.7	61.0–69.0	1.9	3.3
Interorbital breadth	11.1	9.3–12.6	.7	7.6
Length of maxillary tooth row	13.7	12.0–15.0	.7	6.6
Length of audital bullae	10.0	8.0–12.0	.5	8.0
Cranial breadth	26.4	25.0–28.0	.5	3.1
Rostral depth	15.3	14.0–16.0	.4	1.2
Zygomatic breadth	36.4	34.0–38.0	.6	3.0
Length of incisive foramina	18.1	15.0–20.0	.6	6.0

TABLE 2.—*Secondary sexual variation in Lepus americanus washingtoni*

MEASUREMENTS	NUMBER OF MALES	MEAN OF MALES	NUMBER OF FEMALES	MEAN OF FEMALES
Total length	24	412.5	23	413.6
Length of hind foot	23	116.8	28	117.8
Condylobasal length	28	65.3	27	66.0
Interorbital breadth	28	11.1	30	11.1
Maxillary tooth row	27	13.6	30	13.7
Cranial breadth	26	26.7	27	26.8
Rostral depth	26	15.3	30	15.3
Zygomatic breadth	25	36.5	28	36.4
Length of incisive foramina	26	18.1	29	18.0
Breadth of incisive foramina	26	6.7	29	6.7

SECONDARY SEXUAL VARIATION

Since the greatest number of specimens available of any one race belonged to the subspecies *washingtoni*, the amount of secondary sexual variation was studied most carefully in this form. It is assumed that other races will conform to the conditions found in *washingtoni*, as the specimens of other races examined indicate close conformation. Of *washingtoni*, 52 specimens of both sexes were available with external measurements; 24 were males. Fifty-eight specimens with cranial measurements were available of which 28 were males. Some measurements on a few of the broken skulls were not taken. The total number of specimens available for each cranial measurement varies from forty-seven to fifty-eight.

Actual comparisons of means, with standard errors, show no significant difference between the sexes in any measurements. No differences could be detected in color between the sexes. Females average consistently larger than males, but the differences found are much smaller than those found by Orr (1940) for the rabbits of California.

SEASONAL VARIATION

The normal, full, winter pelage of all snowshoe hares, except *washingtoni* and some *klamathensis*, is white. This effect is caused by the large number of white guard hairs present all over the body. On the edges of the ears the fur is blackish. The underfur is thick and soft. On the head and back the underfur is bicolored, being buffy, pinkish, or clay color distally and slaty proximally. The length of the slate colored part is greatest on the sides; it decreases rapidly in length both dorsally and ventrally, being but a few millimeters long in the mid-dorsal region and absent in the mid-ventral region. The underfur of the belly is pure white.

Late in the winter or early in the spring the guard hairs may become broken and worn, exposing the colored underfur. Such hares often present an odd appearance.

The fresh summer pelage comes in as short, stiff, guard hairs that lie flat against the skin. It grows rapidly and usually displaces the winter coat first in the mid-dorsal region a short distance posterior to the shoulders. It next appears on the face, back, and sides. The feet remain white much longer than the rest of the body, sometimes not changing color until mid-summer. A few long, white, guard hairs remain in place on the back and sides for a month or two after the upperparts have changed. The fresh summer pelage is stiff and appressed, but it soon fluffs out with wear, giving a more greyish cast to the entire animal.

The winter coat usually comes in gradually over the entire body. Both summer and winter pelage are retained for a short time, resulting in an odd violet shade of color. In such individuals, however, each hair is either pure white or as dark as the summer coat. No specimen showing bleaching of the summer coat was seen. The white color of the feet is assumed at about the same time as is the color of the body. On some occasions the winter coat seems to be assumed in patches, but not according to any regular plan as noted by Orr (1940).

The summer coat of *washingtoni* is similar to that of other races and is assumed in the same way. The winter coat differs from that of other races in that the guard hairs are slaty basally and colored proximally as in the summer coat. The winter pelage of *washingtoni* is paler, softer, and less appressed than it is in summer.

Nelson called the pelages of the three age groups of hares "juvenile," "post-juvenile," and "adult."

The juvenile coat is short and wooly, and is composed mainly of underfur. The underparts are dull greyish white. The relatively few guard hairs of the upper parts have long greyish or yellowish tips, giving the upper parts a frosted appearance.

In the post-juvenile pelage relatively more guard hairs occur; the pale tips are shorter, and some of them have short black tips. The underparts are dull in color.

In the summer adult the upper parts are smooth and appressed, the areas of pelage are distinct, and there are relatively more guard hairs than are in the post-juvenile coat. All guard hairs of the adult coat have black tips.

The greatest number of young specimens available belonged to the race *washingtoni*, and growth of the skull was studied in this form. The condylobasal length was used as a basis for comparing the other measurements.

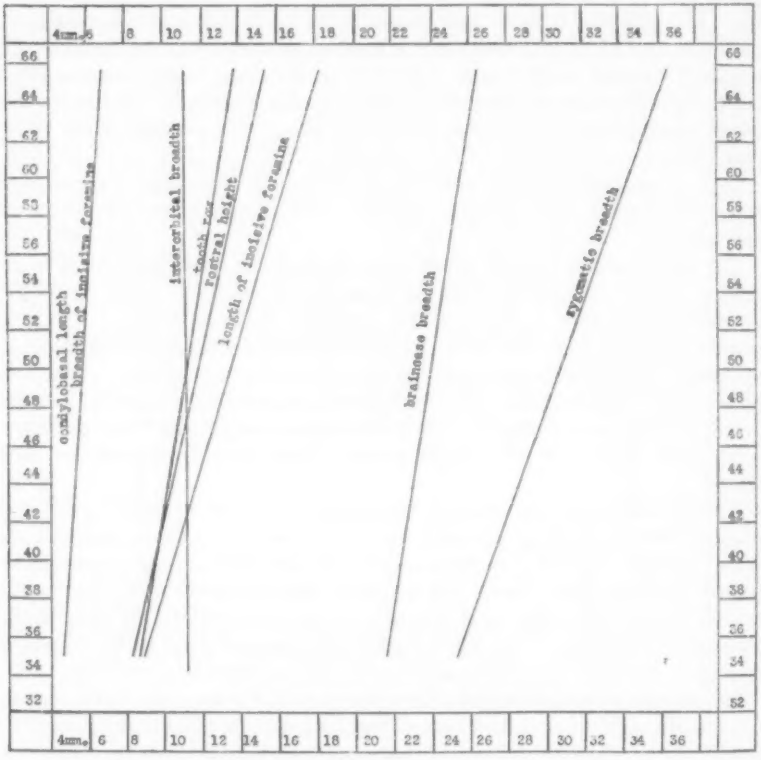

FIG. 1. Growth in the skull of *Lepus americanus washingtoni*.

Maximum interorbital breadth is attained at an age earlier than that of the youngest specimen available. Other measurements recorded in the table seem to reach the adult mean at about the same time as does the condylobasal length. A third set of measurements includes those of length on the dorsal surface of the skull, length of nasals, and length and breadth of rostrum. These increase in size more slowly and do not reach their full size until after the other measurements have done so. These are of less value taxonomically unless the ages of the specimens are known.

From the few "old" specimens examined it appears that the skull continues to grow throughout life. Increased age results in stronger super-orbital processes, increased deposits of calcium on the sides of the maxillaries and audital bullae, and a tendency for all sutures to become indistinct.

GEOGRAPHIC VARIATION

Bergman's law seems to apply to the variation in a north-south direction in the snowshoe hares of British Columbia. The northern most form studied, *macfarlani*, is the largest; to the south of *macfarlani*, in order of decreasing size, are the races *pallidus* and *columbiensis*.

South of British Columbia Bergman's law does not apply. The distribution of the hares in this region is interrupted by the presence of dry Upper Sonoran Zone deserts, not occupied by *Lepus americanus*. In this region are a number of north-south directed mountain ranges, between which are timbered lowlands or valleys, and, in general, the hares of the mountains differ from those of the lowlands. In Washington, Oregon, and Idaho, the hares are best considered as varying from west to east.

TABLE 3.—*Geographic variation in Lepus americanus washingtoni*

MEASUREMENTS	SOUTHERN	CENTRAL	OLYMPIC	NORTHERN
Total length	401.0	410.3	405.1	432.7
Length of hind foot	115.8	115.8	117.0	112.0
Condylobasal length	65.5	65.5	64.9	65.1
Interorbital breadth	11.2	10.8	11.8	11.1
Length of maxillary tooth row	13.4	14.0	13.5	13.8
Cranial breadth	26.4	26.6	26.3	26.5
Zygomatic breadth	35.8	36.5	36.5	36.7
Rostral depth	15.3	15.4	15.3	15.3
Length of incisive foramina	18.5	18.0	17.8	18.0

The westernmost of the southern races is *Lepus americanus washingtoni*, the smallest and darkest of American snowshoe hares. This race occupies the costal lowlands of Washington and Oregon. To the east of the range of *washingtoni*, in the Cascade Mountains, two races of hares are found. These are *cascadensis* in the northern Cascades, north of the Columbia River, and *klamathensis* in the Cascades of Oregon, south of the Columbia River; both of which are larger than *washingtoni*. To the east of the Cascades in Washington is a large Upper Sonoran Zone desert that acts as a barrier to the distribution of these hares. The timbered lowlands and low mountain ranges of eastern Washington and adjacent parts of Idaho are occupied by a small hare, *pineus*. The low mountain ranges of eastern Oregon are occupied by *oregonus*, a medium sized race, while the large *bairdii* occurs over most of Idaho.

It is probable that within the range of any one of the subspecies here considered, average differences of minor importance exist in the populations of geographically segregated localities. Unfortunately there were enough specimens of only one race, *washingtoni*, available to make a careful study of this type of variation.

The 58 available adult specimens of *washingtoni*, with measurements, were arbitrarily divided into four groups as follows: A southern population consisting of hares from costal Oregon, which is separated from the main population of *washingtoni* by the Columbia River; the Olympic population, consisting of hares from the Olympic Peninsula of Washington; a central population from south of

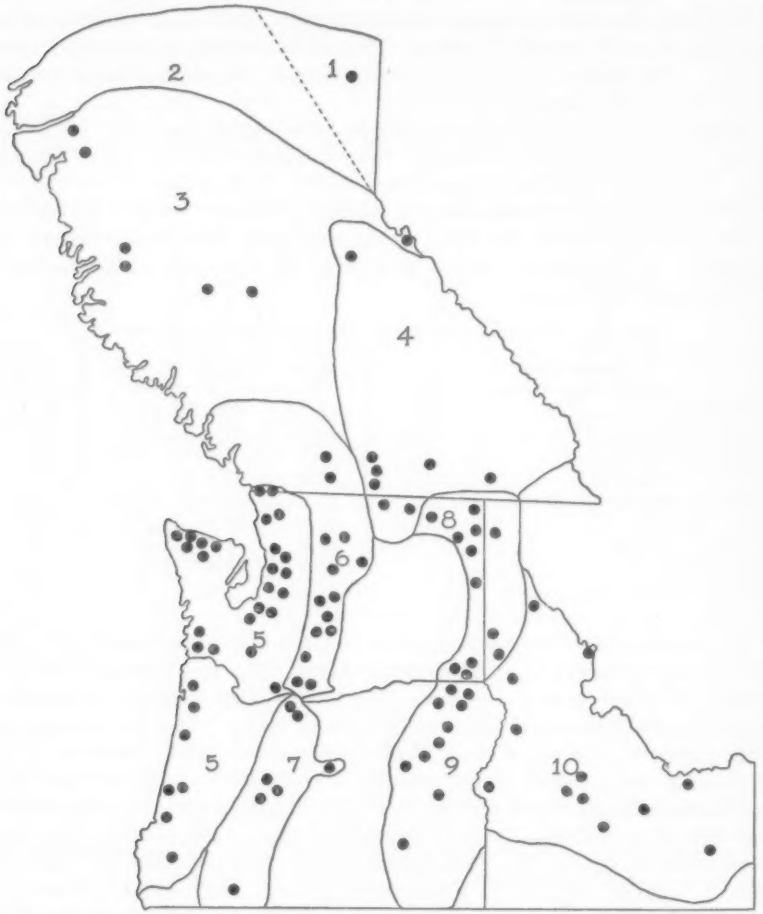

FIG. 2. Distribution of ten races of *Lepus americanus* in the northwest: *1. Lepus americanus americanus, 2. Lepus a. macfarlani, 3. Lepus a. pallidus, 4. Lepus a. columbiensis, 5. Lepus a. washingtoni, 6. Lepus a. cascadensis, 7. Lepus a. klamathensis, 8. Lepus a. pineus, 9. Lepus a. oregonus, 10. Lepus a. bairdii.*

Puget Sound; and a northern population from northwestern Washington and southwestern British Columbia.

The central group is considered typical. The southern group averages paler and less rusty than the central group. The Olympic group also averages paler and less rusty than the central group, but the color is of a more brassy tone than

that of the southern group. The northern group seems slightly darker than the central group. Mean differences in size of the four groups are indicated in the preceding table. Because of the small size of the samples and the resulting large standard errors the differences are not shown to be significant.

INTERRELATIONSHIPS

Nelson (1909) considered the western snowshoe hares as belonging to three species, namely *americanus*, *washingtoni*, and *bairdii*, but strongly suspected that additional material would show that all belonged to the species *americanus*. Of the hares here considered, only five races were known to Nelson and only *columbiensis* was assigned to the species *americanus*.

Racey and Cowan (1935), working with the hares from the Alta Lake region of British Columbia, showed that *cascadensis*, previously considered a subspecies of *bairdii*, intergraded with *columbiensis* and was therefore a subspecies of *americanus*. In 1938 Cowan named *pallidus* from the Chilcotin region of British Columbia and showed intergradation between *pallidus* and *columbiensis*. In the Hazelton area *pallidus* intergrades with *macfarlani*.

Nelson's original error in identifying the hares of the Okanagan region as *cascadensis* (actually topotypes of *columbiensis* as pointed out by Cowan, 1938) served to indicate a range for *cascadensis* much farther east than it actually was. The hares of northeastern Washington were expected to show intergradation between *cascadensis* and *bairdii*, while the hares of southeastern Washington were expected to show intergradation between *bairdii* and *klamathensis*. Examination of considerable material from eastern Washington and adjoining parts of Idaho and British Columbia shows that this region is occupied by a well marked race here called *pineus*. This race intergrades with *columbiensis* on the north, *bairdii* on the east, and *oregonus* on the south. The range of *pineus* is separated from that of *cascadensis* by the dry Okanagan River Valley and also by the range of *columbiensis*. Then *pineus*, *bairdii*, and *oregonus* are connected with *Lepus americanus* by intergrading populations.

Bailey (1936) referred the subspecies *washingtoni* and *klamathensis* to the species *americanus* wihout explanation. Study of considerable material from the western Cascade Mountains of Washington shows that intergradation does take place between *washingtoni* and *cascadensis*, but not evenly and only in a narrow area. Intergradation between *washingtoni* and *klamathensis* was reported by Bailey (1936). All named kinds of northwestern snowshoe hares, then, on the basis of intergradation, belong to the species *americanus*.

DESCRIPTION OF SUBSPECIES

Lepus americanus washingtoni Baird

Lepus washingtonii Baird, Proc. Acad. Nat. Sci. Phil., 1855, p. 333.
Lepus americanus var. *washingtoni*, J. A. Allen, Proc. Boston Soc. Nat. Hist., 875.
Lepus americanus washingtoni, True, Proc. U. S. Nat. Mus., 1885, 128, p. 601.

Type.—No. 1223/280, U. S. National Museum, collected by Dr. George Suckley at Steilacoom, Washington, April 1, 1854.

Range.—West of the Cascade Mountains in British Columbia, Washington, and Oregon; south at least to the Rogue River, Oregon (Bailey, 1936), north to

the Frazer River, British Columbia, and east in the lower Columbia River Valley to White Salmon, Washington.

Color.—In normal summer pelage the upper parts are between Sayal Brown and Cinnamon, but are more rusty. In a few specimens the tips of the guard hairs are Pale Buff, giving a brassy effect. In specimens from the northern part of the range, the tips of the guard hairs are darker than usual. In late summer these tips become broken and the specimens seem bright rusty brown.

Considerable color variation exists in winter-taken specimens. The darkest specimens seen, except for some intergrades between *washingtoni* and *cascadensis*, were from King and Snohomish counties, Washington. Specimens from the Olympic Peninsula of Washington are the palest and somewhat resemble summer specimens of *klamathensis*. In color they are Pale Cinnamon Buff, with the color of the upper parts but slightly washed with blackish. Winter-taken specimens from Oregon and south central Washington are Cinnamon Buff in color.

Measurements.—Fifty-eight adults of both sexes together average: Total length, 413; length of hind foot, 117; condylobasal length, 65.7; interorbital breadth, 11.1; length of tooth row, 13.7; breadth of cranium, 26.4; depth of rostrum, 17.1; zygomatic breadth, 36.4; length of incisive foramina, 18.1; breadth of incisive foramina, 6.7.

Comparisons.—Compared with *cascadensis*, *washingtoni* is darker, less grizzled, does not turn white in winter, and is smaller in all measurements taken except the length of the upper tooth row, which is greater. Compared with *klamathensis*, *washingtoni* is darker, more heavily colored, never turns white in winter, is smaller in external measurements, has a less deep rostrum, a longer upper tooth row, and wider zygomatic arches. Compared with *columbiensis* and races to the east and north, *washingtoni* is smaller, darker, and differs in cranial measurements.

Remarks.—This hare is common over much of its range, but due to its secretive habits it seldom is seen. It is mainly nocturnal or crepuscular and, when disturbed from its daytime hiding places, is apt to slink soundlessly away in the dense underbrush. In areas of open land, such as the glacial prairies of western Washington, it is more often seen, but its feces are no more abundant there than in areas of dense trees or brush.

In April, 1938, at Deer Park, 6,000 feet elevation in the Olympic Mountains, feces of this hare covered the ground at the bases of trees where the snow had melted. All feces were found on the uphill side. These mammals seldom make well defined runways of their own, but use those of other mammals, such as *Aplodontia*. One specimen was trapped in the burrow of an *Aplodontia* and tracks followed in the snow near Seattle, Washington, twice led down burrows of this mammal. Tracking in the snow also disclosed the habit of running along dead logs. The hares often went to considerable trouble to climb or jump upon a log, then ran its entire length and jumped down.

These hares seem to prefer coniferous timber as a habitat, rather than deciduous or mixed woods. The breeding season extends from May through July

(Scheffer, 1933) and two litters of young may be born each year (Dice, 1926). Males with enlarged testes were taken as early as March.

Tracks of weasel were sometimes seen following *Lepus a. washingtoni* tracks, and a weasel was seen to kill a small hare in the Olympic Mountains. Specimens examined of *washingtoni* were usually lightly infested with tapeworms, ticks, fleas, and mites, and one heavy infestation of ectoparasites was seen. No tularemia has yet been reported from *washingtoni*.

Intergradation was reported between *washingtoni* and *klamathensis* by Bailey (1936). Specimens showing intergradation between *washingtoni* and *cascadensis* were examined from Skykomish, Mt. Rainier, Vance, and Mt. Adams, Washington, and Point Grey, British Columbia.

Specimens examined.—Total number 90, as follows: **British Columbia:** Point Grey, 1 (Prov. Mus. of B. C.); Hastings, 1 (Biol. Surv. Coll.); Sumas, 10 (Mus. Comp. Zool. 6, Biol. Surv. Coll. 4); Chilliwak, 2 (Mus. Comp. Zool.). **Washington:** *Skagit Co.:* Mt. Vernon, 8 (Biol. Surv. Coll.). *Clallam Co.:* Sekiu River, 1 (Chas. R. Connor Mus.); Clallam Bay, 2 (U. Mich.); Sol Duc Burn, 1; Happy Lake, 3 (Field Mus.); Boulder Lake, 6 (Field Mus. 5, C. R. Connor Mus. 1); Johnsons Ranch, 1 (Field Mus.); Port Angeles, 1 (C. R. Connor Mus.); Deer Park, 1 (V. B. Scheffer). *King Co.:* Paradise Lake, 1; Cottage Lake, 2; Seattle, 1; Renton, 1; Bothell, 1 (U. Wash.). *Pierce Co.:* Nisqually, 3 (Phil. Acad. Sci.); Steilacoom, 2 (U. S. Nat. Mus.); Lake Kapowsin, 2 (U. Mich. 1); McKenna, 1 (U. Mich.). *Thurston Co.:* Olympia, 1 (U. Mich.). *Pacific Co.:* Shoalwater Bay (Willapa Bay), 1 (U. S. Nat. Mus.); Ilwaco. 1 (V. B. Scheffer). *Wahkiakum Co.:* Skamokawa, 6. *Klickitat Co.:* White Salmon, 2 (Biol. Surv. Coll.). *County ?:* Chilloweyuck Depot, 2 (U. S. Nat. Mus.). **Oregon:** *Tillamook Co.:* Tillamook, 7 (U. Mich. 2, Alex. Walker 3, Ore. State College 1); Netarts, 1 (S. G. Jewett); Blaine, 5 (U. Mich. 4, Phil. Acad. Sci. 1). *Lane Co.:* Mercer, 2 (S. G. Jewett 1, Ore. State Coll. 1); Florence, 1 (S. G. Jewett). *Douglas Co.:* Drew, 1 (Biol. Surv. Coll.).

Lepus americanus klamathensis Merriam

Lepus klamathensis Merriam, N. A. Fauna 16, 1899, p. 100.
Lepus washingtoni klamathensis, Nelson, N. A. Fauna 29, 1909, p. 107.
Lepus americanus klamathensis, Bailey, N. A. Fauna 55, 1936, p. 95.

Type.—Adult female no. 92248, U. S. National Museum, Biological Surveys Collection, taken by B. L. Cunningham, January 25, 1898, at Fort Klamath, Klamath County, Oregon; original number 86.

Range.—The Cascade Mountains, from Mount Hood, Oregon, south to Trinity County, California (Orr, 1940); in Oregon bounded on the west by the range of *washingtoni* and on the east by Upper Sonoran Zone desert.

Color.—Upper parts in summer between Sayal Brown and Cinnamon, but more vinaceous, remainder of body as in *washingtoni*. In brown winter coat, softer, and more vinaceous than in summer. In white winter coat, the entire body is white except for the dusky borders of the ears and the eyelids. The underfur in winter is varying shades of salmon.

Measurements—Averages of 22 adult males and females: Total length, 423; length of hind foot, 132; condylobasal length, 65.3; interorbital breadth, 11.2; tooth row, 13.3; cranial breadth, 26.7; rostral depth, 15.8; zygomatic breadth, 35.8; length of incisive foramina, 18.3; breadth of incisive foramina, 6.8.

Comparisons.—Compared with *washingtoni* from the Oregon coast, *klama-*

thensis is paler, having a brassy rather than a rusty tone. Compared with specimens from the Olympic Peninsula of Washington, *klamathensis* is almost indistinguishable. Some *klamathensis* turn white in winter, while *washingtoni*, so far as is known, never does so. Compared with *cascadensis*, *klamathensis* is paler, and brassy rather than coppery brown, with the head coloration not sharply marked off from that of the body, and with a relatively short, narrow skull. Compared with *oregonus*, *klamathensis* is smaller with a shorter, narrower skull but longer tooth row. The color of *klamathensis* is darker and less grizzled, with a dark head not sharply marked off from the lighter colored body.

Remarks.—According to Bailey (1936) and Orr (1940), the habits of *klamathensis* are similar to those of *washingtoni*, except as the former inhabits a more mountainous region. Bailey mentions these hares as digging burrows in the snow. This seems to be the only case recorded of any northwestern race of snowshoe hare actually digging. From the rather large series obtained by some collectors, it would seem that *klamathensis* must be at least locally common.

This race is probably derived from a population of *Lepus americanus* forced south into western Oregon during the Pleistocene. Following the melting of the ice sheet, a portion of the population reinvaded western Washington, a second portion remained in western Oregon, while a third, *klamathensis*, occupied the Cascade Mountains and became differentiated from the coastal populations. It is probable that the Californian race, *tahoensis*, was also derived in this manner.

Specimens examined.—Total number 32, from Oregon, as follows: *Hood River Co.*: Parkdale, 1 (Biol. Surv. Coll.). *Clackamas Co.*: Mount Hood, 2 (Biol. Surv. Coll.); Estacada, 1 (Biol. Surv. Coll.). *Crook Co.*: Mouth of Davis Creek, 15 (Ore. State Coll.). *Lane Co.*: Bellknap Springs, 1 (Ore. State Coll.); Blue River, 1 (Biol. Surv. Coll.); Three Sisters, 1 (Biol. Surv. Coll.). *Klamath Co.*: Fort Klamath, 10 (U. Mich. 9, Ore. State Coll. 1).

Lepus americanus cascadensis Nelson

Lepus bairdi cascadensis Nelson, Proc. Biol. Soc. Wash., vol. 20, p. 87, 1907.
Lepus americanus cascadensis, Racey and Cowan, Ann. Rept. Prov. Mus. of British Columbia, 1935.

Type.—Adult male no. 1886, Museum of Comparative Zoology, collected by W. C. Colt near Hope, British Columbia, June 12, 1894.

Range.—The Cascade Mountains of Washington and British Columbia, from Mt. Adams, Washington, on the south to Jervis Inlet, British Columbia, on the north (Cowan, MS); bordered on the west, south of the Frazer River, by the range of *washingtoni*, on the north by the range of *pallidus*, and on the east by the range of *columbiensis* and the eastern Washington desert.

Color.—In summer the upper parts are near Orange Cinnamon; head Cinnamon, tail and rump blackish, sides and chest-band pale Cinnamon, underparts and chin white. In winter the entire body is snow white, except for the dusky borders of the ears and the blackish eyelids. The underfur in winter is

Pale Pinkish Cinnamon on the back, becoming slate color basally, with slate more extensive on sides and rump.

Measurements.—Average of 27 adults of both sexes: Total length, 434; length of hind foot, 132; condylobasal length, 66.2; interorbital breadth, 11.1; length of tooth row, 13.3; cranial breadth, 26.8; rostral depth, 16.0; zygomatic breadth, 36.9; length of incisive foramina, 18.5; breadth of incisive foramina, 6.8.

Comparisons.—Compared with *washingtoni*, *cascadensis* is larger, more coppery in color, with the head more sharply marked off from the body. Compared with *columbiensis*, *cascadensis* is darker, more coppery in color, with a shorter body, longer hind foot, and shorter, narrower skull. Compared with *pallidus*, *cascadensis* is smaller, darker, and has a smaller skull.

Remarks.—This hare is locally abundant in some localities but it is seldom seen due to its secretive habits. By driving along a mountain road at night as many as four or five to a mile may be seen. After a fresh fall of snow their tracks may be found in areas of coniferous timber. Under heavy timber they make broad trails through the dry needles, but through brush or deciduous trees they prefer to pick their own way. In summer they are most abundant in underbrush or swamps, but in winter, when the leaves are off the trees, they almost never go there. Forms are usually placed under logs.

The principal enemies of the Cascade snowshoe hare are probably the great horned owl and the coyote. On Mount Rainier the present scarcity of snowshoe hares is blamed on the coyote. In areas where lynxes are found, according to trappers, the big cats prey almost entirely on hares. Tracks of weasels that had been following hares were seen in the snow in the Cascade Mountains on several occasions.

Two cases of tularemia were found in the hares of the Skykomish Valley, Washington. Some specimens were found to be heavily infested with castor bean ticks. Other parasites found include small yellow mites, lice, fleas, nematode worms, and tapeworms. No marked periodic fluctuations in numbers were noted, but trappers say that local fluctuations are common.

Racey and Cowan (1935) found that *cascadensis* intergrades with *columbiensis* east of the Cascade Mountains in British Columbia. In Washington the range of *cascadensis* is separated from that of *columbiensis* by the dry Okanagan River Valley. The Columbia River prevents intergradation with *klamathensis*, on the south. Along the western border of the Cascade Mountains, *cascadensis* intergrades with *washingtoni*, and to the north it probably intergrades with *pallidus*.

Specimens examined.—Total number 50, as follows: **British Columbia:** Alta Lake, 2 (Provincial Mus.); Black Mountain, 1 (Prov. Mus.); Hope, 7 (Mus. Comp. Zool.). **Washington:** *Chelan Co.:* Stehekin, 1 (Biol. Surv. Coll.); Lake Chelan, 1 (Biol. Surv. Coll.); Entiat River (20 miles from mouth), 1 (Biol. Surv. Coll.). *King Co.:* Tye, 1; Skykomish, 11. *Kittitas Co.:* Lake Keechelus, 5 (Phil. Acad. Sci.); Easton, 1 (Biol. Surv. Coll.); Lake Easton, 5 (U. Mich. 4); Martin, 5 (Phil. Acad. Sci.). *Pierce Co.:* Mt. Rainier, 3 (Nat. Park Serv. 2, Biol. Surv. Coll. 1). *Lewis Co.:* Vance, 2 (S. G. Jewett). *Klickitat Co.:* 15 mi. N. Carson, 1 (Biol. Surv. Coll.); Trout Lake, 1 (Biol. Surv. Coll.).

Lepus americanus pineus new subspecies

[*Lepus americanus*] *pineus* Dalquest, *nomen nudum*, Bull. Univ. Washington, 6 (Abstracts of Theses): 199, February 28, 1942.

Type.—Adult female, skin and skull no. 53867, University of Michigan Museum of Zoology, collected by P. Putnam at Cedar Mountain (Moscow Mountain), Latah County, Idaho, May 29, 1921; original number 6.

Range.—The Blue Mountains of Washington, north through the Panhandle of Idaho and eastern Washington into the adjoining part of British Columbia. West in northern Washington to the Kettle River Mountains.

Color.—Upper parts in summer Cinnamon Brown, sides as back but paler, rump and top of tail blackish, head between Sayal Brown and Cinnamon, hips Light Olivaceous Buff, chin and belly white, chest-band light Cinnamon, ears blackish, often edged with white. In winter the entire body is white except for the dusky borders of the ears and the blackish eyelids. The winter underfur is usually Pale Pinkish Cinnamon, rarely Light Vinaceous Cinnamon or Orange Cinnamon, with basal portion of the underfur slaty.

Measurements.—Average of 16 adults of both sexes: Total length, 419.2; length of hind foot, 132.8; condylobasal length, 65.7; interorbital breadth, 11.6; length of tooth row, 13.1; cranial breadth, 27.3; depth of rostrum, 16.2; zygomatic breadth, 36.9; length of incisive foramina, 18.1; breadth of incisive foramina, 7.0.

Comparisons.—Compared with *bairdii*, *pineus* is smaller, redder, less washed with blackish, less grizzled, with browner head and relatively longer, narrower skull, and broader incisive foramina. Compared with *oregonus*, *pineus* is darker, redder, with browner head, is smaller in size, with smaller, narrower skull and narrower interorbital region. Compared with *columbiensis*, *pineus* is darker, with the dark-colored head more sharply marked off from the lighter-colored body, and is smaller in all measurements taken except the interorbital breadth, which is relatively and actually greater in *pineus*. Compared with *cascadensis*, *pineus* is paler, less coppery, with shorter body, wider interorbital region, wider cranium, and shorter incisive foramina.

Remarks.—This hare is abundant over much of its range. I found it most common in dense growths of young pine trees. There its runways and droppings could be found almost everywhere. Males in breeding condition were taken in June, and nursing females in July. The only parasites noted were castor bean ticks and fleas.

Intergradation takes place between *pineus* and *columbiensis* in the Kettle River Mountains of Washington and the Kootenay Valley of British Columbia. Intergradation takes place between *pineus* and *bairdii* to the east of the Panhandle of Idaho.

A series of twelve specimens from the Blue Mountains of Washington is rather puzzling. On geographic grounds one would expect them to belong to *oregonus*, to which race Orr (1934) referred two of them. Examination of a larger series than he had available, however, shows that this is not the case. In color, total length, zygomatic breadth, and cranial breadth, they resemble *pineus*. In length of incisive foramina they are like *oregonus*. In depth of

rostrum and breadth of incisive foramina they resemble *bairdii*. In the possession of a small hind foot, wide interorbital region, and long tooth row, they differ from all three. I consider color and total length to be the best diagnostic characters and on this basis the Blue Mountains series must be referred to *pineus*. For the sake of convenience the Washington-Oregon boundary is considered the southern limit of the race *pineus*.

A specimen from near Creston, Kootenay Valley, British Columbia, is colored liked *pineus*, but in large size and large skull is more like *columbiensis*, to which race it is referred.

Specimens examined.—Total number 31, as follows: **Idaho:** *Bonner Co.:* 5 mi. W. Cocolalla, 2. *Latah Co.:* Cedar Mountain (Moscow Mountain), 6 (Chas. R. Connor Mus. 5, U. Mich. 1); Troy, 1 (U. Mich.); Feltons Mills, 1 (C. R. Connor Mus.). **Washington:** *Pend Oreille Co.:* 5 mi. N. Newport, 1. *Stevens Co.:* Deep Lake, 1; Marcus, 1 (Biol. Surv. Coll.); 5 mi. N. Colville, 2 (Biol. Surv. Coll.); Calispell Peak, 2 (Biol. Surv. Coll.). *Ferry Co.:* Republic, 1 (Biol. Surv. Coll.). *Spokane Co.:* Newman Lake, 1 (C. R. Connor Mus.). *Garfield Co.:* Blue Mountains, 1 (C. R. Connor Mus.). *Columbia Co.:* Blue Mountains, 4 (C. R. Connor Mus. 2); Bartholomew Springs, 1 (U. Mich.); Group Place, 4 (U. Mich.); Stay-a-while Springs, 1 (U. Mich.); Alhambra, 1 (U. Mich.); Godman Springs, 1.

Lepus americanus oregonus Orr

Lepus bairdi oregonus Orr, Jour. Mamm., May, 1934, vol. 15, no. 2, p. 152.

Type.—Adult female skin and skull no. 54887, Museum of Vertebrate Zoology, collected by Robert T. Orr twelve miles south of Canyon City, Grant County, Oregon, June 25, 1932; original number 557.

Range.—Eastern Oregon, bounded on the north by the range of *pineus*, on the east by the Snake River and the range of *bairdii*, and on the west and south by desert regions.

Color.—In summer the upper parts are greyish Cinnamon, washed with blackish, sides and chest-band pale Cinnamon, head varying from Cinnamon to Pinkish Buff, hips light Ochraceous Buff, underparts and chin white. Winter pelage not seen.

Measurements.—Average of 17 adults of both sexes: Total length, 432.5; hind foot, 133.3; condylobasal length, 66.8; interorbital breadth, 12.6; length of tooth row, 13.1; breadth of cranium, 27.5; depth of rostrum, 16.3; zygomatic breadth, 37.0; length of incisive foramina, 18.6; breadth of incisive foramina, 7.0.

Comparisons.—Compared with *pineus*, *oregonus* is greyer, less reddish, larger, with longer, wider skull, wider interorbital region, and longer incisive foramina. Compared with *bairdii*, *oregonus* is smaller, with smaller hind foot, longer, narrower skull, wider interorbital region, deeper rostrum, longer, wider incisive foramina, and paler head. Compared with *klamathensis*, *oregonus* is paler, with much paler head and more greyish upper parts, with more massive skull, but shorter tooth row.

Remarks.—According to Orr (1934), this hare inhabits dense thickets and small openings in yellow pine forests at high altitudes. Orr found individuals rather easy to approach. Hares were seen most often in mornings and evenings. Orr took two nursing females and one pregnant female, containing five embryos 16 mm in length, and a male in breeding condition, on June 25 and 26, 1932.

Orr (*ibid*) considered the smaller size of *oregonus*, as compared with *bairdii*, to represent an approach to *klamathensis*. There is, however, no reason to think that this is the case. Considering the difference between *oregonus* and *klamathensis*, and the probable origin of *klamathensis* from *washingtoni*, it would seem likely that intergradation between *oregonus* and *klamathensis* would be similar to that between *washingtoni* and *cascadensis*. That is, in a narrow band, but a few miles wide. Intergradation between *oregonus* and *klamathensis* is not shown in material at hand. Hares examined from Crook County, less than 75 miles west of the type locality of *oregonus*, are in such poor pelage that whether they resemble *oregonus* or *klamathensis* in color cannot be determined. In size and cranial characters they are like topotypes of *klamathensis*.

The smaller size of *oregonus*, as compared with *bairdii*, follows the general rule that snowshoe hares of higher mountainous areas are larger than those of lower areas. The general range of *oregonus* is the arid mountain ranges of eastern Oregon, altitudinally lower than that of the larger *bairdii*, but higher than that of the smaller *pineus*.

Specimens examined.—Total number 18, all from Oregon, as follows: *Wallowa County:* 22 mi. N. Enterprise, 1 (S. G. Jewett); Bear Creek Ranger Station, 1 (S. G. Jewett); Lostine (10 mi. S., 2 mi. E.), 1; Lostine (16 mi. S., 2 mi. E.), 4; Wallowa Lake, 3 (Biol. Surv. Coll.). *Baker Co.:* Sumpter, 1 (Biol. Surv. Coll.). *Union Co.:* Telocaset (7 mi. E.), 1. *Grant Co.:* Canyon City (12 mi. S.), 3; Strawberry Mountain, 1 (Biol. Surv. Coll.). *Harney Co.:* Ochoco National Forest, 1 (S. G. Jewett); Summit of Blue Mountain, 1 (S. G. Jewett).

Lepus americanus bairdii Hayden

Lepus bairdii Hayden, Amer. Naturalist, vol. 3, pp. 115–116, May, 1869.
Lepus americanus var. *bairdii*, Allen, Proc. Bost. Soc. Nat. Hist., 1875.
Lepus americanus bairdii, True, Proc. U. S. Nat. Mus., vol. 7, p. 601, 1885.

Type.—Number 4262/38001, U. S. National Museum, collected by F. V. Hayden near Fremont Peak, Wind River Mountains, Wyoming, June 2, 1860.

Range.—Mountainous and timbered parts of Idaho, except the Panhandle; eastward into Montana and south to New Mexico.

Color.—In summer the upper parts are grayish Cinnamon washed with blackish, sides and chest-band pale Cinnamon, head varying from Cinnamon to Pinkish Buff, hips light Ochraceous Buff, underparts and chin white. In winter the entire body is white except for the blackish eyelids and the dusky borders of the ears. The underfur in winter is Pale Pinkish Cinnamon, with the basal portion slaty.

Measurements.—Average of 14 adults of both sexes: Total length, 442.7; length of hind foot, 136.6; condylobasal length, 65.5; interorbital breadth, 11.9; length of upper tooth row, 13.2; cranial breadth, 27.7; rostral depth, 15.9; zygomatic breadth, 37.4; length of incisive foramina, 18.1; breadth of incisive foramina, 6.8.

Comparisons.—Compared with *pineus*, *bairdii* is more grayish, more washed with blackish, more grizzled, with yellower head, and is larger with larger skull. Compared with *oregonus*, *bairdii* has a larger body with longer, narrower skull, and a slightly darker head.

Remarks.—According to Davis (1939), *bairdii* "is typical of alpine meadows, stream side thickets, and forests." Like other snowshoe hares, *bairdii* is mainly nocturnal or crepuscular in habits. Davis took a half grown young on July 1, and pregnant females on July 1, July 29, and July 30. Davis suggests that this may indicate a long breeding season and more than one litter of young a year. Davis also mentions specimens as sometimes being heavily infested with mites and ticks.

Specimens examined.—Total number 16, from Idaho, as follows: *Shoshone County:* Bitterroot Valley, 1 (U. S. Nat. Mus.). *Clearwater Co.:* Weippe, 2. *Washington Co.:* Cuddy Mountain, 1. *Payette Co.:* Payette, 1. *Clark Co.:* Humphry, 1 (Biol. Surv. Coll.). *Custer Co.:* Big Lost River, 2 (Biol. Surv. Coll.). *Blaine Co.:* Alturas Lake, 1; Ketchum, 1 (Biol. Surv. Coll.); Sawtooth Lake, 2 (Biol. Surv. Coll.); Redfish Lake, 1. *Bannock Co.:* Pocatello, 1. *County ?:* Sinyakwatun Depot, 1 (U. S. Nat. Mus.); Resort, 1 (Biol. Surv. Coll.).

Lepus americanus columbiensis Rhoads

Lepus americanus columbiensis Rhoads, Proc. Acad. Nat. Sci. Phil., June, 1895. p. 242.

Type.—Adult female number 7462, Philadelphia Academy of Natural Sciences, collected by S. N. Rhoads at Vernon, British Columbia, July 29, 1892; original number 462.

Range.—From north-central Washington, north to Indianpoint Lake, British Columbia, and from the Cascade Mountains east in British Columbia to the Rockies. In Washington from the Okanagan Valley east to the Kettle River Mountains.

Color.—In summer the upper parts are Cinnamon Brown, with the head slightly paler, top of tail and small rump patch blackish, sides and chest-band as back but paler, hips light Ochraceous Buff, underparts and chin white. In winter the entire body is white except for the blackish eyelids and dusky borders of the ears. One winter taken specimen is Warm Buff dorsally, washed with blackish. The rump, tail, and underparts are white, with the Clay Color of the underfur showing through. The ears are white-edged with dusky and spotted with Cinnamon, and the chest-band and sides are Light Ochraceous Buff.

Measurements.—Average of 16 adults of both sexes: Total length, 431; length of hind foot, 141; condylobasal length, 67.2; interorbital breadth, 11.1; length of tooth row, 13.2; cranial breadth, 27.6; rostral depth, 16.2; zygomatic breadth, 37.5; length of incisive foramina, 18.6; breadth of incisive foramina, 7.3.

Comparisons.—This race is paler and less coppery than *cascadensis*, with the color of the body less sharply marked off from the head, and with shorter hind foot, longer skull, greater spread of the zygomatic arches, but less interorbital breadth. Compared with *pineus*, *columbiensis* is more brownish, with the color of the head less sharply marked off from the body. Measurements larger for all characters except the interorbital breadth, which is smaller.

Remarks.—According to reports, this race is locally abundant, makes well-defined runways, and is susceptible to periodic fluctuations in numbers. In Washington they were found to be most abundant in coniferous timber and

swamps. Near Indianpoint Lake most specimens seem to have been taken in a willow-deciduous tree habitat.

In some respects this race bridges the gap between the northern hares (*americanus, pallidus, macfarlani*) and the darker southern races.

The rather large series of specimens at the California Museum of Vertebrate Zoology from Indianpoint Lake, though intermediate in most respects, is referable to *columbiensis* on the basis of the predominately brown upper parts. A series from the same locality at the Provincial Museum of British Columbia, on the other hand, seems referable to *pallidus*. It is possible that specimens referable to both forms occur in the Indianpoint Lake region, but occur at different elevations or in different habitats. A specimen from Creston, British Columbia, is colored like *pineus*, but in size and cranial characters is like *columbiensis*.

Specimens examined.—Total number 38, as follows: **British Columbia:** Indianpoint Lake, 25 (Prov. Mus., 8, not typical); Cottonwood Post Office, 2; Mount Revelstoke, 2 (Prov. Mus.); Vernon, 1; Okanagan, 9 (Biol. Surv. Coll.); Okanagan Landing, 1; Creston, 1 (Cal. Acad. Sci.). **Washington:** *Okanagan Co.:* Moulson, 1 (Biol. Surv. Coll.). *Ferry Co.:* Danville 3 (U. Mich.).

Lepus americanus pallidus Cowan

Lepus americanus pallidus Cowan, Jour. Mamm., May, 1938, p. 242.

Type.—Adult female skin and skull number 4717, Provincial Museum of British Columbia, collected July 29, 1931, by Ian McTaggert Cowan at Chezacut Lake, British Columbia; original number 943.

Range.—Central British Columbia, from the Indianpoint Lake region north to Hazelton, and from the Coast Range east to the Rockies. Northeastern extent of range unknown.

Color.—In summer the upper parts are of an olive tone, near Pinkish Cinnamon, washed with blackish, with blackish rump patch; sides of head Cinnamon Buff, hips Pinkish Cinnamon, underparts white. In winter the entire body is white, except for the dusky borders of the ears and the blackish eyelids.

Measurements.—Average of 21 adults of both sexes: Total length, 468; length of hind foot, 131; condylobasal length, 68.1; interorbital breadth, 11.4; length of tooth row, 13.9; breadth of cranium, 28.1; rostral depth, 16.7; zygomatic breadth, 38.2; length of incisive foramina, 19.3; breadth of incisive foramina, 7.7.

Comparisons.—Compared with *americanus*, *pallidus* is less washed with long blackish guard hairs and is more olive, less grey, in color. Compared with *macfarlani*, *pallidus* is more olive in color, not "salt and pepper," and is less washed with long blackish guard hairs.

Remarks.—The large series from Hazelton and the Kispiox Valley is intermediate between *pallidus* and *macfarlani* but is uniformly more olive in color and less washed with blackish than are specimens of *americanus* and *macfarlani* available to me.

Specimens examined.—Total number 22, all from British Columbia, as follows: Kispiox Valley, 23 mi. N. Hazelton, 9; Hazelton, 7; Anahim Lake, 3; Chezacut Lake, 1 (Prov. Mus.); Berg Lake, Mt. Robson, 1; Bonaparte River, 5 days north of Ashcroft, 1 (Phil. Acad. S .).

LITERATURE CITED

Allen, J. A. 1875. Synopsis of the American Leporidae. Proc. Boston Soc. Nat. Hist., vol. 17, pp. 333–336.

Bailey, Vernon. 1936. The mammals and life zones of Oregon. U. S. Dept. Agric., Bur. Biol. Surv., N. A. Fauna no. 55, pp. 1–116.

Cowan, Ian McTaggert. 1938. Notes on the hares of British Columbia, with description of a new race. Jour. Mamm. vol. 19, no. 2, pp. 242–243.

Dice, Lee R. 1926. Notes on Pacific Coast hares and pikas. Occas. Papers Mus. Zool., Univ. Mich., no. 166, pp. 1–28.

Davis, William B. 1939. The recent mammals of Idaho. Caxton Printers, Caldwell, Idaho, pp. 1–400.

Nelson, E. W. 1909. The rabbits of North America. U. S. Dept. Agric., Bur. Biol. Surv., N. A. Fauna no. 29, pp. 1–314.

Orr, Robert T. 1934. Description of a new race of snowshoe rabbit from eastern Oregon, with notes on its life history. Jour. Mamm., vol. 15, pp. 152–154.

———— 1940. The rabbits of California. Occ. Papers California Acad. Sci. 19, pp. 1–207.

Racey, Kenneth, and I. McTaggert Cowan. 1935. Mammals of the Alta Lake Region of British Columbia. Ann. Rept. Prov. Mus. of B. C.

Ridgway, Robert. 1912. Color Standards and Color Nomenclature. Washington, D. C.

Scheffer, Theo. H. 1933. The breeding of the Washington varying hare. Murrelet, vol. 14, pp. 77–78.

True, Fredric W. 1885. A provisional list of the mammals of North and Central America and the West Indian islands. Proc. U. S. Nat. Mus., vol. 7, pp. 587–611.

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A CONVENIENT METHOD OF PHOTOGRAPHING SMALL MAMMALS

By R. M. Bond

Published photographs of rodents and other small mammals are not always so good as could be wished, and an effective method of photographing them may prove useful.

The method used to produce the accompanying illustrations is well shown in Plate 1. It was worked out with the assistance of Mr. Rodney B. Radford, in charge of visual information, Pacific Southwest Region, Soil Conservation Service. A piece of cardboard about 18″ wide is bent to form a right angle, and a few leaves, a tuft of grass, or a stone is placed in the corner. It is surprising how easily a wild and nervous rodent may be herded into the angle and kept there while it is photographed.

To get the whole animal in focus and to stop the rapid motion requires that the lens be stopped down, that the shutter be operated rapidly, and consequently that the light source be bright, and the film rapid. The best combination I have found for a 4 x 5 speed graphic camera is *f*:32 at 1/200 second, using a large flash bulb operated synchronously with the shutter, and a film with a Weston

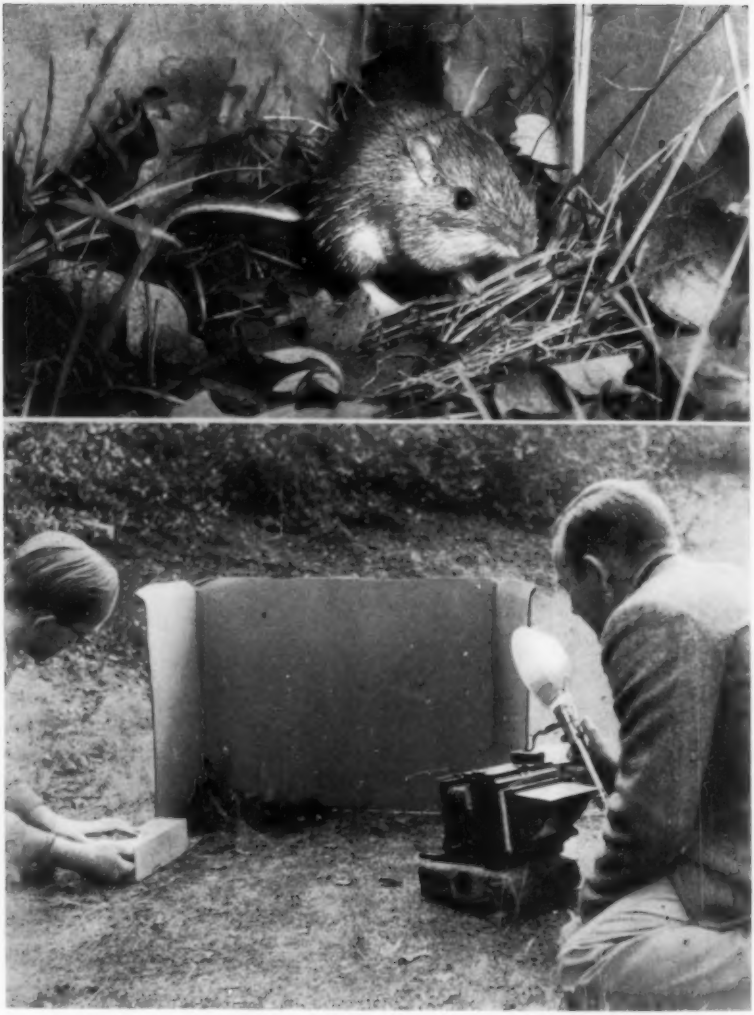

PLATE 1

UPPER: *Perognathus californicus californicus*, photographed in the open at the Hastings Natural History Reserve. LOWER: Method of photographing small mammals.

PLATE 2

UPPER: *Peromyscus maniculatus sonoriensis*, photographed indoors on a table. LOWER: *Peromyscus californicus californicus*, photographed in the open at the Hastings Natural History Reserve.

rating of 100. Even at this speed, the feet and the head are difficult to "stop" (see Plate 2). The camera is prefocussed, 2½ to 3 feet distant, and the animal maneuvered into the field, since it cannot be depended upon to stay put long enough to focus the camera on it. The daylight affects the negative enough to lighten the shadow, and gives a more pleasing and useful photograph than is usually obtained by a trigger operated flash at night.

Soil Conservation Service, Berkeley, California.

A FAMILY OF DOG-COYOTE HYBRIDS

By Lee R. Dice

Hybrids between dogs and coyotes are occasionally reported in North America, but for most of these the paternity is assumed from the appearance of the young rather than definitely known. Matings between dogs and coyotes do, however, take place and Olaus Murie (1936: 355–356) has described a hybrid fetus from a coyote mother and dog father.

Crosses between the wolf and the dog have long been known to produce hybrids of which both sexes are fertile (Przibram, 1910, vol. 3: 109). It is not known, however, whether the hybrids between dogs and coyotes are also fertile. It therefore seems desirable to place on record the following account of a family of hybrids derived from a coyote mother and dog father. Unfortunately none of these hybrids lived to reach maturity and the data on sterility obtained is therefore inconclusive.

Most of the dogs and coyotes used in this study were kept on the Edwin S. George Reserve of the University of Michigan through the permission of Director F. M. Gaige. Special thanks are due Lawrence Camburn, Custodian of the Reserve, who took care of the experimental animals and who also gave the services of his dog. Cages for the animals were donated by the Cranbrook Institute of Science. Food and other materials were provided by the Laboratory of Vertebrate Genetics. The use of one male coyote kept by the University Museums in an outdoor exhibit was granted by Crystal Thompson, Curator of Visual Education.

The female coyote used in the studies was a gift from Joseph Stephenson of the Michigan Department of Conservation. The several male coyotes were the gift of Adolph Stebler, also of the Department of Conservation. The female coyote was trapped in Cheboygan County, Michigan, the males in Alger County. The female dogs employed in attempted crosses with the male coyote were mongrels. The male dogs were both hounds, one marked black and white, the other black and tan.

MATINGS BETWEEN COYOTES AND DOGS

Attempts to secure matings between male coyotes and female dogs were all failures. Two female dogs in heat were placed with the male coyote at the

Museums' outdoor exhibit during the summer of 1937. The attempts of the male to mount the females were feeble and copulation was not accomplished. Another female dog in heat was placed frequently with the male coyote between January 4 to 11, 1938, again without a successful copulation, although the coyote attempted a few times to mount her. The male coyote was about 16 months old in the summer of 1937 and probably nearly two years of age in January of 1938, and he should accordingly have been mature. It is possible that the male might not have been in breeding condition in the summer, but this could not have been true in January. The failure to breed may have been due to the distractions caused by the presence of other animals, especially the nearby bears, or the whole artificial situation may have prevented the instincts of the male from properly expressing themselves.

The adult female coyote kept on the George Reserve came into heat in early February, 1937, as shown by signs of blood in her cage. A male dog copulated with her on February 7. The two remained connected for 28 minutes. A week later she refused to accept the dog, which may indicate that copulation occurred near the end of her period of heat. No young resulted from this mating.

The female coyote again began to drop blood on January 19, 1938, but she refused to accept the male dog on that date. Beginning January 24 one male dog was placed with her each morning and the other male dog each afternoon. Between January 24 and 27 she accepted both males frequently, but at no time until the 27th did either remain connected with her. Beginning on the afternoon of the 27th and continuing until the afternoon of the 31st each dog once a day became connected with the female, these connections persisting from 14 to 24 minutes each. On the morning of January 31, however, she refused one dog, and after this date she would not accept either dog. On March 30 a litter of 3 pups was born. This allows a possible maximum period of gestation for this litter, counting from the first connection with a male dog on January 27, of 62 days; and a minimum, counting from the last copulation on January 31, of 58 days.

CHARACTERS OF THE HYBRIDS

One of the hybrid pups produced was a male, the other two were females. In this cross the male sex is therefore produced. The number of hybrids is, however, too few to prove that there is no disturbance of the sex ratio.

In pelage color one of the two hybrid females was marked black and tan, while the other and the hybrid male were gray, somewhat like their coyote mother. The muzzles of all the pups were narrow, although not quite so much so as the muzzle of their mother. Their ears were large and were lopped down, resembling those of their hound father or fathers. The feet of the hybrids were relatively large, in this character being somewhat like the hound. Their walk was always rather clumsy and they did not have the quick, agile movements of the coyote.

The pups were rather quarrelsome among themselves, and the male, which was the largest, dominated the two females. When the smaller female was returned to the cage with the others, after she had been away for a few days receiving treatment for an infection, her brother attacked her so viciously that she had to

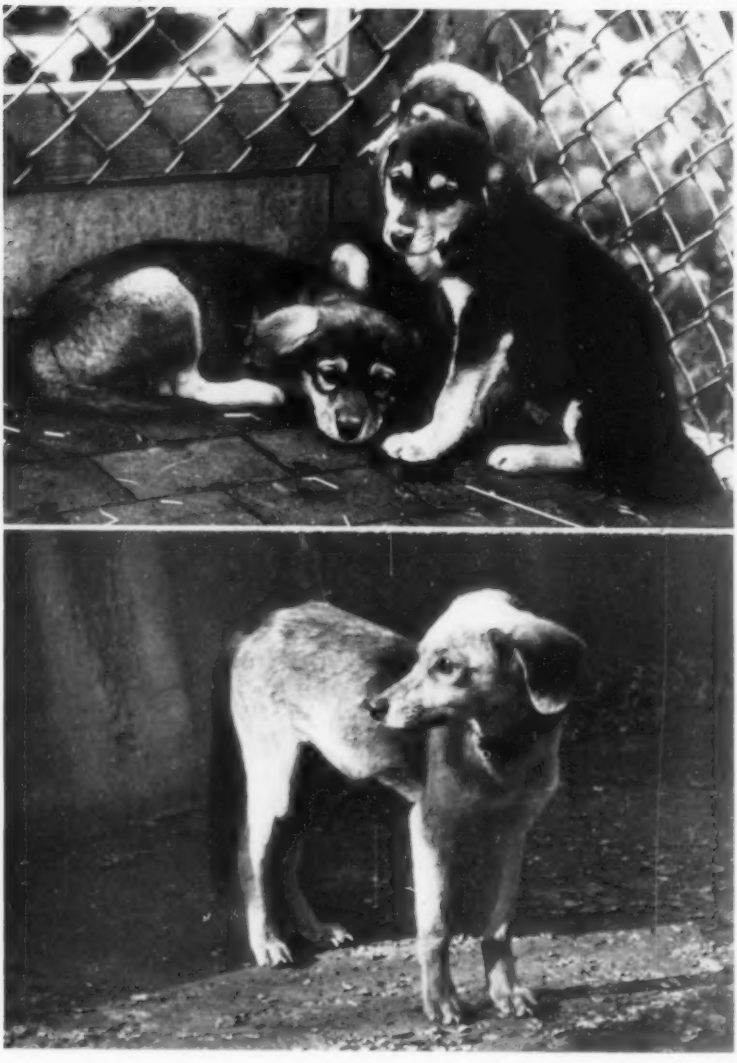

PLATE 1

UPPER: The three coyote-dog hybrids at the age of 53 days. The black-and-tan female is in front at the right.

LOWER: The gray female hybrid at the age of 7 months. The ears are moderately large and are lopped, the muzzle is fairly slender, the feet and legs are moderately heavy, the tail is well furred, and the hair on the body is not very long.

be removed and thereafter kept separate. Although only ten weeks old at the time, the male puppy's teeth were so long and so sharp that he drew blood wherever he bit her, and he soon would have killed her. All the pups were timid and wild. They were, however, always kept in pens and large runs. It is possible that if they had been handled more frequently their natural shyness would have been overcome.

The voices of the pups are said by Mr. Camburn to have been of two types. The black-and-tan female is said to have had a dog-like bark, while the gray female and the gray male had a coyote-like yelp. Mostly they were silent when I was near them and I never heard the dog-like bark. All the pups died at too young an age to have developed their full vocal powers.

The pups all became infected with round worms during the summer of 1938, and were given medical treatment for this ailment. They were also all given anti-distemper injections. The black-and-tan female hybrid unfortunately developed an infection at the place of injection. She was treated and began to recover, but later developed symptoms of canine distemper and died on July 9, aged 71 days.

During the late summer the hybrid male gradually developed a paralysis of the hind limbs, which by October had entirely deprived him of their use. He was accordingly killed on October 19 and prepared as a specimen. At that time he was 203 days or a little more than six and one-half months of age. It is possible that the paralysis resulted from a non-fatal attack of canine distemper.

The remaining hybrid female seemed healthy until near the end of November, when she began to refuse her food and a few times seemed in a partial stupor. In this condition she would bump into objects as she moved about. She died on November 30, when just 8 months old. She was in good condition at the time and on autopsy she proved to have a moderate amount of fat. There was no apparent abnormality in either her digestive or genital tracts.

The testes of the male hybrid, which was killed at the age of six and one-half months, were cut up and fixed immediately in Bouin's solution. They later were sectioned and treated with various stains. An examination of this material by Assistant Ray Moree shows that the spermatogonia and the spermatogonial divisions apparently are normal. The maturation divisions, on the contrary, seem to be highly abnormal. No divisions are found in any stage later than very early anaphase of the first maturation division. After this stage only abnormal cells are to be found. Many degenerate cells are present in the lumens of the seminiferous tubules and a few in the epididymis, but no spermatozoa occur in either the testis or epididymis. These observations have been confirmed by Professor Peter Okkelberg. It is true that this hybrid male was immature and partially paralyzed. Nevertheless, it would be expected that in a normal animal of this age maturation of the germ cells would be in progress. The indication is, therefore, that this hybrid would have been sterile, because of the failure of production of spermatozoa.

The skins of two of the pups were preserved, from the black-and-tan female

and from the gray male. Both of these are now in the collection of the Division of Mammals, Museum of Zoology.

The black-and-tan hybrid female is black in color all over the body and on most of the tail, but the legs, feet, muzzle, throat, chin, and eye-rings are a rich tan. The ears are marked with black and rich tan. There is a pale tan stripe on the proximal part of the underside of the tail. The underside of the body, especially the pectoral area, has markings of tan and white. The overhairs on the back are black throughout their length, and there is no indication of an agouti pattern. The underfur on the back is a dark brown. In the tan-colored areas the hairs are tan in color over their whole length and again there is no indication of an agouti pattern. On the ventral side of the body are many whitish guard hairs. The hair is short all over the body, and the tail hairs also are much shorter than those of the coyote.

The male hybrid appears superficially to be coyote-like in color, but it differs in a number of characters from a coyote of comparable season killed October 17 in Delta County, northern Michigan. The upperparts, especially the upper side of the tail, of the hybrid appear more blackish than in the coyote, and the underparts, feet, muzzle, eye-rings, and ears are a richer tan in color. The hair of the hybrid is much shorter than that of the coyote, and, although of a general agouti type, the dorsal hairs do not have so many bands as those of the coyote. The contour hairs on the middle of the back are mostly whitish in color, with long black tips. Some of the guard hairs of the dorsal area, however, are black for their full length. The wool hairs are grayish at their bases, and pale tan in color over most of the rest of their length. On the middle of the underside of the body the guard hairs are pale tan in color, much like those of the coyote. The wool hairs of the underside of the hybrid, however, are dusky at the base, with the rest of the shaft of each hair pale tan.

The coyote from northern Michigan used for comparison has most of the guard hairs on the middle of the back white over the proximal third, blackish brown over the middle third, while the distal third is made up a wide, subterminal, tan band and a nearly equally long black tip. Another less common type of guard hair has a short, whitish basal portion, a very long black middle portion, a wide, tan, subterminal band, and a long black tip. The several bands of color on the guard hairs often pass gradually into one another. The wool hairs of this coyote are grayish at the base and shade to a deep tan at the distal end. On the underside of the coyote both the guard hairs and the wool hairs are pale tan in color over their whole length.

The skulls and skeletons of the hybrids have been compared with coyote specimens of as nearly similar ages as possible. Comparable age has been assumed when the various teeth are in similar stages of eruption. No comparison with the bones of the dog has been possible because of the lack of comparable dog skeletons.

A sexual difference in size among the hybrids is evident. The male, which died at the age of 6½ months has a considerably larger skull and longer and heavier bones than the female that died at the age of 8 months. The male was

noticeably larger at all ages than either of his sisters. There is a similar sexual difference in the coyote, for in that species the adult males have longer and heavier skulls and limb bones than the females.

The bones of the hybrids are somewhat lighter in weight and less well calcified than the bones of coyotes of comparable age. There is, however, no evidence that any of the hybrids suffered from ricketts. The skulls of the hybrids are about the same in total length as those of coyotes of comparable sex and age, but are broader in all their parts, including the muzzle and the brain case. The limb bones, likewise, are about the same in length as those of comparable coyotes, but are considerably larger, especially their heads.

The internal cusp on the fourth upper premolar is well developed in the hybrids. This cusp is variable in the coyote, but is usually well developed. In the wolf, on the contrary, it is usually lacking.

HEREDITY OF COYOTE AND DOG CHARACTERS

From the evidence at hand little can be said about the heredity of the characters that distinguish coyotes from dogs. It seems obvious, however, that the black-and-tan pattern of the hound is dominant to the all-over, agouti pattern of the coyote. This is proved by the appearance of one black-and-tan animal in the hybrid litter. The lack of pronounced color pattern on the other two hybrid pups might be due to descent from a different father, for it will be remembered that the female coyote was mated to two male hounds, only one of which had the black-and-tan pattern. Or, possibly, if the same hound was the father of the entire litter, this hound is heterozygous instead of homozygous for the black-and-tan pattern.

The length of hair was much less in all the hybrid pups than in the coyote of comparable season. It is not certain that the hair of the hybrid pups was as short as that of the hound at the same seasons and ages. The general appearance of the hybrids compared with living hounds, however, indicates that the hair of the hybrids was little if any longer than that of the hound. This might imply that the short hair of the hound is dominant to the longer hair of the coyote.

The guard hairs on the backs of the two grayish hybrids are not banded in the same manner as those of the coyote. None of these hairs in the hybrids seems to have more than two bands of color, a main grayish part and a long black tip. On the back of the coyote, on the contrary, the guard hairs are of two general types, both of which have four bands of color. From the data at hand, however, it is impossible to make any suggestion about the possible heredity of these hair types.

The ears of the hybrids were much larger than those of the coyote and instead of being carried erect were lopped as in the hound. No measurements of the ears of hounds are available, but the ears of the hybrids seemed in life to be somewhat smaller, and therefore intermediate in size between those of the hound and the coyote. A blending type of heredity for ear size is suggested.

The muzzles of the hybrid pups were noticeably more slender in life than those

of the hound and seemed more closely to resemble those of the coyote. In the preserved skulls, however, it is evident that the muzzles of the hybrids are heavier than those of the coyote. In this character, therefore, the hybrids are intermediate between their parent species and a blending type of heredity is indicated.

The skull and limb bones of the hybrids are about equal in length, but considerably thicker than those of the coyote of comparable age and sex. No bones of the hound are available for comparison, but it may be assumed that these would be in general still larger than those of the hybrids. If this be true, the bones of the hybrids are intermediate in thickness between those of the two parent species, and the character probably is inherited in a blending manner.

SUMMARY

Matings of two different male hounds with a female coyote produced a litter of 1 male and 2 female hybrid pups. The period of gestation was between 58 and 62 days. One female hybrid pup died at the age of 10 weeks, the male at 6½ months, and the other female at 8 months. In the testis of the immature male, spermatogenesis was abnormal and no functional spermatozoa were produced. Accordingly this male was probably sterile.

The black-and-tan color pattern of the hound seems to be dominant in heredity to the gray agouti coloration of the coyote. The hair of the hybrids was much shorter in length than that of the coyote, and was probably not much, if any, longer than that of the hound. The size of ear, heaviness of muzzle, width of skull, and thickness of limb bones of the hybrids seem to be in general intermediate between the two parent forms.

LITERATURE CITED

Murie, Olaus J. 1936. Dog skulls from St. Lawrence Island, Alaska. Miscl. Publ. Univ. Alaska, vol. 2, pp. 347-357, 8 figs.

Przibram, Hans. 1910. Experimental-zoologie. Leipzig and Wien: Franz Deuticke. 3 vols.

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AN EFFECT ON THE *PEROMYSCUS MANICULATUS* RASSENKREIS OF LAND UTILIZATION IN MICHIGAN

By Emmet T. Hooper

Deforestation and subsequent cultivation of lands in Michigan have resulted in the contraction of the ranges of forest-inhabiting species and the expansion in the ranges of species preferring grasslands and other open situations. Some species and races that once occurred over most of the state are now restricted to the northern part and to isolated uncleared areas scattered over the southern part. Other species and races that prior to the advent of the white man either were entirely absent from Michigan or occurred only in restricted areas in the extreme southern tiers of counties now occupy most of the lower peninsula and some of the upper peninsula. The subspecies *Peromyscus maniculatus gracilis* and *Peromyscus maniculatus bairdii* well illustrate the changes that have ensued in the distribution of certain members of the *Peromyscus maniculatus* Rassenkreis, or chain of closely related geographic races.

The two races, *gracilis* and *bairdii*, are closely restricted to certain habitats, and their "original distribution"—prior to the advent of the white man—without much doubt corresponded closely to the distribution of those habitats. The race *gracilis* inhabits dense mixed forests of beech, maple, yellow birch, and associated trees. It avoids open forests and grasslands. On the other hand *bairdii* inhabits prairies, open fields, and lake beaches, and is entirely absent from dense forests. The original distribution of the two races in the lake states probably conformed in general to that of the main mass of the northeastern hardwoods forests and of the tall-grass prairies, respectively. That this is likely true is further indicated by the concurrence of their respective ranges, as outlined by Osgood in 1909 (*ibid*), with the distribution of the northeastern hardwoods forests and the tall-grass prairies (Schantz and Zon, 1924). The ranges indicated by these authors probably closely approximate the primitive ranges.

In Michigan, *gracilis* probably occurred throughout the upper peninsula and in the lower peninsula south about to the southern limits of the high plains, approximately the latitude of the head of Saginaw Bay. The occurrence of *gracilis* farther south in Michigan is subject to considerable doubt. The southern limits of the high plains mark a natural break in the continuity of the flora and fauna. The northeastern hardwoods forests give way to the more xerophytic southern hardwoods dominated by oak and hickory, and certain members of the eastern fauna attain either their northern or their southern limits there (Dice, 1938). It is an area where a kind of mammal closely associated with the northeastern hardwoods might well be expected to attain the southern limits of its range. Further reason to doubt the occurrence of *gracilis* south of the high plains is derived from the collections in the Museum of Zoology. If *gracilis* occurred in southern and central Michigan one hundred years ago, it is logical to assume that it should still be present in some of the uncleared areas that remain in that part of the state, and that specimens of it should have resulted from the extensive

collecting done in those areas. Actually there are no unquestionable records of *gracilis* from the southern half of the state. The specimen recorded from Ann Arbor by Dice (1931) either is an abnormal example of *bairdii* or was mislabeled

FIG. 1. Present distribution of *Peromyscus maniculatus gracilis* and *P. m. bairdii* in Michigan, as determined from specimens contained in the Museum of Zoology, University of Michigan.

by the collector and did not come from the vicinity of Ann Arbor at all; Dice (oral communication) concurs with me in this opinion. The race *bairdii* was restricted to the few isolated areas of prairie and "oak openings" which occurred

in the southwestern part of the state (Veatch, 1928) and possibly to sand dunes bordering the Great Lakes. The two races were, thus, in juxtaposition in Michigan in but a few local areas, at most; they may have been completely separated geographically.

About the middle of the nineteenth century lumbering operations, which previously had been casual and restricted principally to areas around the few settlements, began to be carried out on a large scale. Lands all over the state—first those near streams, then, with the advent of the railroad, those inland—were purchased for the timber at a few dollars an acre. Every few miles, as the railroads pushed northward, mills were set up to exploit the timber. Each of these was a nucleus for a settlement; around some of them the cut-over land was taken up for agriculture. Most of these settlements perished with the passing of lumbering but a few survived and were foci for the agriculture-minded settlers that were to follow. Following the cessation of the extensive lumbering operations in the late 1800's and the subsequent collapse of most of the settlements that the operations had attracted, much of the land was deserted and a period of readjustment ensued, characterized by the gradual settlement of the lands and the conversion of them for agricultural and other purposes to which they are put today.

The present distribution of *gracilis* and *bairdii* is a corollary of the transformations of the landscapes in Michigan. The race *bairdii* now occurs in its appropriate habitat over almost all of the lower peninsula and over the southwestern part of the upper peninsula. It has been recorded as far north as Charlevoix County in the lower peninsula (Dice, 1925), and has recently been taken at several localities in the southern half of Menominee County. The race *gracilis* now is restricted to the upper peninsula and to the northern four tiers of counties in the lower peninsula (fig. 1).

What is the present status of the two races with respect to intergradation and interbreeding? Heretofore, evidence of their intergradation or interbreeding, in the wild state, has been lacking (Osgood, 1909; Dice, 1931). Now that the two are known to be in juxtaposition over fairly large areas and more specimens are available for study, is there evidence of intergradation? There is none, possibly because the two continue to remain ecologically separated—*gracilis* in the woods and *bairdii* in grasslands.

Modifications in the use of land in Michigan, thus, have effected corresponding changes in the ranges of two races in the *Peromyscus maniculatus* chain of races. The range of one has been decreased, the other increased and the two races have been brought into juxtaposition over extensive areas in Michigan, each, however, still maintaining its identity completely and not intergrading with the other. The original distribution of the Rassenkreis has been distorted. As clearing and settlement continues in the eastern United States perhaps *bairdii* will come into contact with other races of *maniculatus* from which it has been separated in the past—with *maniculatus* (the race) in southern Manitoba, for example, or with *nubiterrae* in the Appalachian Mountains.

LITERATURE CITED

DICE, LEE R. 1925. A survey of the mammals of Charlevoix County, Michigan, and vicinity. Occ. Pap. Mus. Zool. Univ. Mich., no. 159, pp. 1–33, 3 plates.

——— 1931. The occurrence of two subspecies of the same species in the same area. Jour. Mammalogy, vol. 12, pp. 210–213.

——— 1938. The Canadian biotic province with special reference to the mammals. Ecology, vol. 19, pp. 503–514, 1 fig.

OSGOOD, WILFRED H. 1909. Revision of the mice of the American genus Peromyscus. U. S. Dept. Agr. Bur. Biol. Surv., N. Amer. Fauna, no. 28, pp. 1–285, 8 pls., 12 figs.

SHANTZ, HOMER L. and ZON, RAPHAEL. 1924. Natural Vegetation. Atlas of American Agriculture, pt. 1, sec. E, pp. 1–29, 60 figs. [advance sheets, 6].

VEATCH, JETHRO O. 1928. The dry prairies of Michigan. Pap. Mich. Acad. Sci., Arts, Let., vol. 8, pp. 269–278, 1 pl., 3 figs.

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SYSTEMATIC RELATIONSHIPS OF PEROMYSCUS AND SEVERAL RELATED GENERA AS SHOWN BY THE BACULUM

BY W. FRANK BLAIR

The characters of the baculum (*os penis*) never have been used in studies of the systematic relationships within the genus *Peromyscus* nor in the determination of the relationships between this and allied genera. An opportunity to describe the bacula of four subgenera of *Peromyscus* and of two related genera, *Onychomys* and *Reithrodontomys*, is afforded by specimens of these forms in the collection of the Laboratory of Vertebrate Genetics. A comparison between the bacula of *Baiomys* and *Peromyscus* is made possible by a stock of *Baiomys taylori subater* from Jefferson County, Texas. For the comparisons, the bones have been drawn to scale in dorsal outline on cross-ruled paper from measurements made with dial calipers under a dissecting microscope. All of the bacula illustrated are of fully mature animals. Those of the laboratory born *Peromyscus* are 42 weeks or more of age. The wild caught *Peromyscus* were kept in captivity from one month to more than a year before being killed. The *Baiomys* had been in captivity about 9 months, after being trapped in the field. The *Onychomys* and *Reithrodontomys* were adult field killed animals.

GENUS PEROMYSCUS

Subgenus Peromyscus.—Of the subgenus *Peromyscus*, representatives of 4 species groups are available. The *maniculatus* group is represented by *P. maniculatus bairdii* (fig. 1, D) and *P. polionotus albifrons* (fig. 1, E). From the *leucopus* group, there are *P. leucopus tornillo* (fig. 1, F) and *P. gossypinus gossypinus* (fig. 1, G). The *boylii* group is represented by *P. boylii attwateri* (fig. 1, A). Of the *truei* group, *P. truei truei* (fig. 1, B) and *P. nasutus nasutus* (fig. 1, C) are available. In the discussion only the species names will be used.

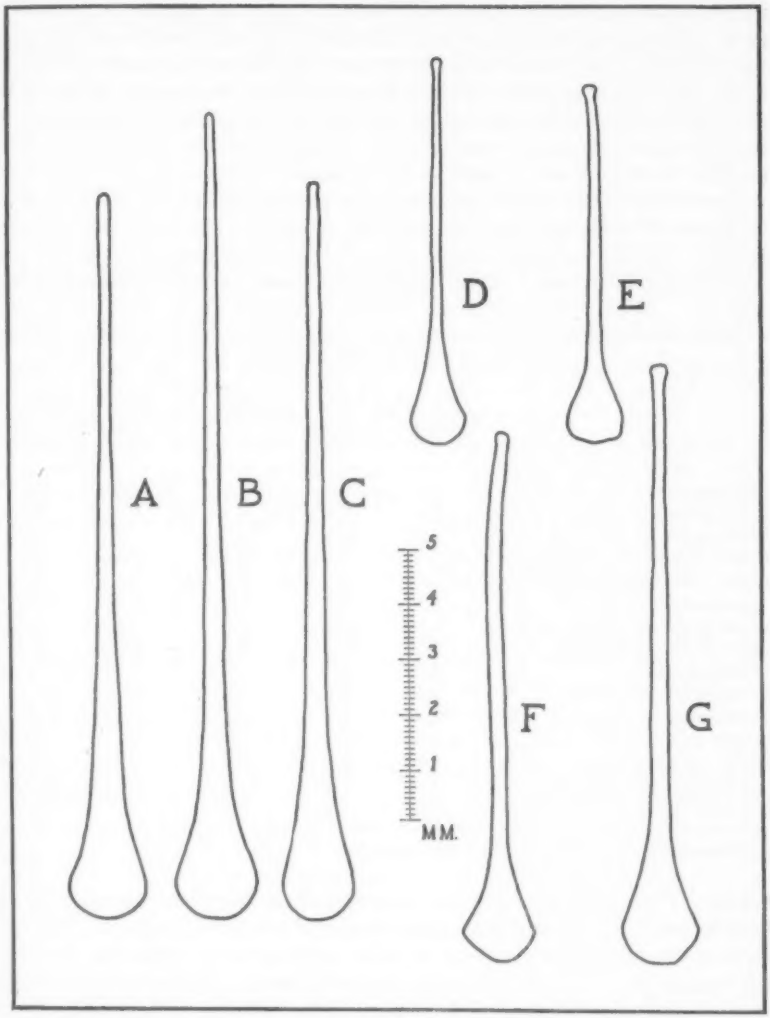

FIG. 1. Outline drawings in dorsal view showing bacula of 7 species of mice of the subgenus *Peromyscus*. (A) *P. boylii attwateri*, (B) *P. truei truei*, (C) *P. nasutus nasutus*, (D) *P. maniculatus bairdii*, (E) *P. polionotus albifrons*, (F) *P. leucopus tornillo*, (G) *P. gossypinus*.

Bacula of representatives of the subgenus *Peromyscus* are shown in figure 1. In this subgenus, the baculum is a relatively slender rod of bone with a comparatively small flat base. In the *maniculatus* and *leucopus* species groups the basal

portion is proportionately broader in relation to the total length of the baculum than in the *boylii* and *truei* groups. In the former groups the greatest basal width of the baculum is contained in the total length from 6.5 times in *polionotus* of the *maniculatus* group to 7.7 times in *gossypinus* of the *leucopus* group (Table 1). In the *boylii* and *truei* groups the baculum is relatively elongated. In these groups the greatest basal width is contained in the total length of the baculum from 9.4 times in *boylii* to 10.2 times in *nasutus* of the *truei* group.

The slender bacula of the *boylii* and *truei* groups are very similar and afford no means of distinguishing between the species nor between these species groups. The mice of these species groups have the most elongated baculum in proportion to body length of any species of *Peromyscus* except *californicus* of the

TABLE 1.—*Measurements of bacula and ratios of basal width to total length and of baculum length to animal's body length*[1]

	GREATEST BASAL WIDTH OF BACULUM IN MM	LENGTH OF BACULUM IN MM	NO. TIMES GREATEST BASAL WIDTH CONTAINED IN LENGTH OF BACULUM	BODY LENGTH OF ANIMAL IN MM	NO. TIMES LENGTH OF BACULUM CONTAINED IN BODY LENGTH
Peromyscus boylii	1.4	13.1	9.4	108	8.2
Peromyscus truei	1.5	14.6	9.7	101	6.9
Peromyscus nasutus	1.3	13.3	10.2	—	—
Peromyscus maniculatus	1.0	7.0	7.0	—	—
Peromyscus polionotus	1.0	6.5	6.5	72	11.1
Peromyscus leucopus	1.3	9.6	7.4	103	10.7
Peromyscus gossypinus	1.4	10.8	7.7	99	9.2
Peromyscus californicus	2.2	15.3	6.9	117	7.6
Peromyscus crinitus	1.9	8.2	4.3	—	—
Peromyscus eremicus	1.8	8.3	4.6	101	12.2
Peromyscus floridanus	0.6	7.1	11.8	104	14.6
Peromyscus nuttalli	1.1	3.6	3.3	87	24.2
Onychomys leucogaster	1.0	5.7	5.7	—	—
Reithrodontomys humulis	0.4	5.4	13.5	64	11.8
Baiomys taylori	0.5	3.1	6.2	63	20.3

[1]Same specimens as shown in figures 1 and 2.

subgenus *Haplomylomys*. In *boylii* the length of the baculum is contained in the body length 8.2 times, and in *truei* it is contained 6.9 times (Table 1). The proportions are approximately the same as in *californicus*, in which the length of the baculum is contained 7.6 times in the body length. The bacula of the *boylii* and *truei* groups are considerably curved dorso-ventrally. Little difference in the amount of curvature is evident in the three species available.

The baculum in the *maniculatus* and *leucopus* groups is actually and relatively smaller than in the *boylii* and *truei* groups. In *gossypinus* the length of the baculum is contained 9.2 times in the body length, in *leucopus* it is contained 10.7 times, and in *polionotus* it is contained 11.1 times. In these groups, the baculum shows only slight dorsoventral curvature.

In brief, the *maniculatus* and *leucopus* species groups are characterized by a very similar, relatively small, straight, slender baculum with a relatively broad base. There are no marked qualitative differences between the species nor between the two species groups. The *boylii* and *truei* groups have a slender, relatively long baculum that is strongly curved dorso-ventrally. No marked qualitative differences are evident between the species of the *boylii* and *truei* groups nor between the two species groups.

Subgenus Haplomylomys.—Specimens of *Peromyscus californicus insignis* (fig. 2, A), *P. eremicus eremicus* (fig. 2, G), and *P. crinitus crinitus* (fig. 2, F), all belonging to the subgenus *Haplomylomys*, are available.

The baculum of *californicus* is relatively slender. Nevertheless, it is heavier throughout than the slender bacula of the *boylii* and *truei* groups. The basal portion is relatively much broader. The greatest basal width is contained in the total length only 6.9 times. In proportion to the animal's body length, the baculum is elongated approximately the same as in the *boylii* and *truei* groups. The length of the baculum is contained 7.6 times in the body length. Dorso-ventral curvature of the baculum is approximately the same as in the *boylii* and *truei* groups.

The baculum is quite similar in *eremicus* and *crinitus*. It is relatively short and has a broad base in these forms. In *eremicus* the greatest basal width is contained only 4.6 times in the length of the baculum, and in *crinitus* it is contained only 4.3 times. In these two species the baculum is very short in proportion to the length of the animal's body. In *eremicus* the length of the baculum is contained 12.2 times in the body length. No body measurements of the specimen of *crinitus* were made, but this species is of approximately the same size as *eremicus* and has a baculum of approximately the same length. In both species, the baculum is curved dorso-ventrally near the tip.

Briefly, the baculum in the subgenus *Haplomylomys* is of two distinct types, represented by the actually and relatively long structure in *californicus* on the one hand, and by the actually and relatively short baculum of *eremicus* and *crinitus* on the other. The differences between these two types are fully as great, if not greater, than those in the subgenus *Peromyscus* between the *maniculatus* and *leucopus* species groups on the one hand and the *boylii* and *truei* groups on the other.

Subgenus Podomys.—The baculum of *Peromyscus floridanus*, the only member of this subgenus, is shown in figure 2, H. In *floridanus*, the baculum is a small, slender, very simple rod of bone, with the basal portion relatively thicker and more rounded than in the other subgenera of *Peromyscus*. The greatest basal width is contained 11.8 times in the length of the baculum. In this species, the baculum is shorter in proportion to the length of the animal's body than in the subgenera *Peromyscus* and *Haplomylomys*. The length of the baculum of *floridanus* is contained 14.6 times in the length of the animal's body. The baculum is moderately curved dorso-ventrally. Its slender, proportionately small

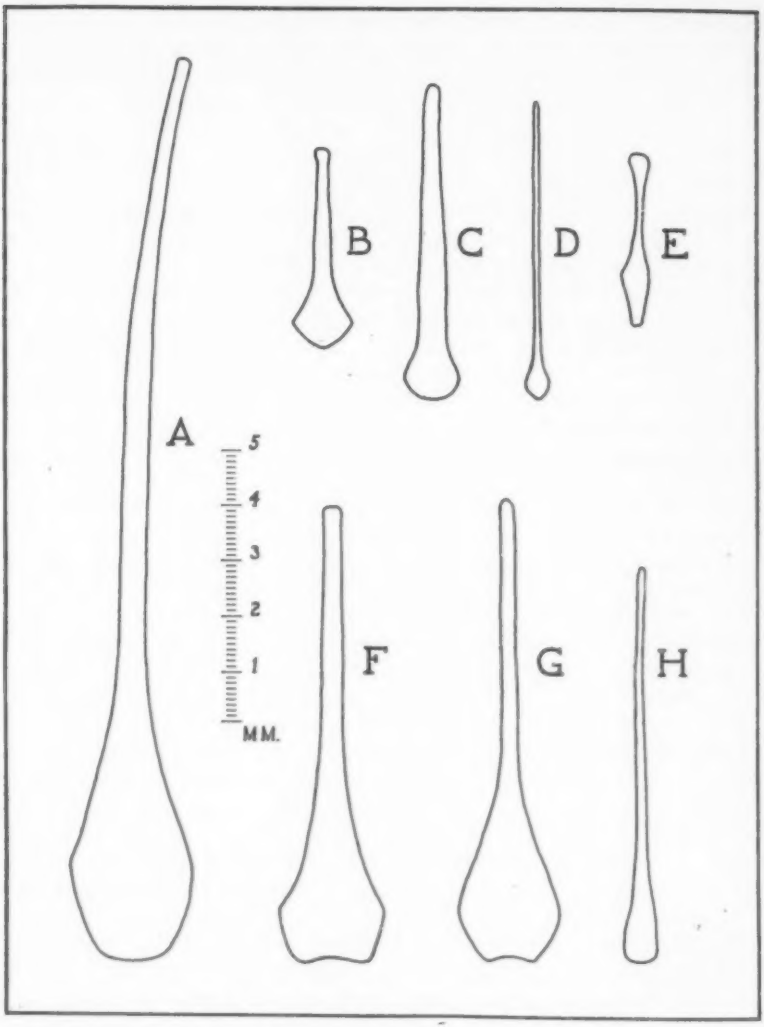

FIG. 2. Outline drawings in dorsal view of bacula of 4 genera of small mammals. (A) *Peromyscus (Haplomylomys) californicus insignis*, (B) *Peromyscus (Ochrotomys) nuttalli nuttalli*, (C) *Onychomys leucogaster ruidosae*, (D) *Reithrodontomys humulis merriami*, (E) *Baiomys taylori subater*, (F) *Peromyscus (Haplomylomys) crinitus crinitus*, (G) *Peromyscus (Haplomylomys) eremicus eremicus*, (H) *Peromyscus (Podomys) floridanus*).

baculum, with its rounded base, easily distinguishes *floridanus* from any other species of *Peromyscus* at hand.

SUBGENUS OCHROTOMYS

The baculum of *Peromyscus nuttalli nuttalli*, the only species of this subgenus, is shown in figure 2, B. The baculum of this form shows remarkable differences from the three other subgenera of *Peromyscus* that have been examined. The base is relatively more thickened than in the subgenera *Peromyscus* and *Haplomylomys*. Laterally the base ends in distinct points that are directed dorso-laterally. The base is broader in proportion to the length of the baculum than in the other *Peromyscus*. The greatest basal width is contained only 3.3 times in the length of the baculum. The baculum is much smaller in relation to body length in *nuttalli* than in any species of *Peromyscus* at hand. The length of the baculum is contained in the animal's body length 24.2 times. The tip is distinctly knobbed. In its actually and relatively small size, and in the other characters enumerated, the subgenus *Ochrotomys* differs more from the other subgenera of *Peromyscus* than any of the other three subgenera differ among themselves.

Relationships within the Genus Peromyscus.—In the subgenus *Peromyscus*, the *maniculatus* and *leucopus* species groups have bacula of the same general type. Representatives of the *boylii* and *truei* groups, too, show a close similarity in baculum type. These natural groupings indicated by the bacula of these mice are in accord with the morphological and skeletal evidence, which indicates close relationships between the *maniculatus* and *leucopus* groups on the one hand and between the *boylii* and *truei* groups on the other.

In the subgenus *Haplomylomys*, two distinct groups are indicated by the character of the baculum. The species *crinitus* and *eremicus* fall into one group characterized by a short baculum with a wide base. The species *californicus* has a long baculum that sets it apart from *crinitus* and *eremicus*.

The subgenera *Peromyscus*, *Haplomylomys*, and *Podomys* form a fairly compact group on the basis of the characters of the baculum. These characters easily serve to distinguish between the subgenera, but the bacula in the three subgenera have certain general features in common. The shaft of the baculum is relatively long in proportion to the width of the base. The entire baculum is relatively elongated in proportion to the length of the animal's body. The principal divergences are evident in the baculum of the subgenus *Podomys* and in the *crinitus—eremicus* group of the subgenus *Haplomylomys*.

The subgenus *Ochrotomys*, represented by the single species *nuttalli*, differs greatly from the other subgenera of *Peromyscus* at hand in having a proportionately small baculum. Also, the baculum is shorter in proportion to the width of the base than in any other of the *Peromyscus* examined. These characters of the baculum as well as the dental, skeletal, and morphological peculiarities of *Ochrotomys* pointed out by Osgood (1909: 222) indicate a more distant relationship than that between the other forms assigned to the genus *Peromyscus*. *Ochrotomys* is so different from the other *Peromyscus* as to raise the question as to whether its relationships might be better shown by elevating *Ochrotomys* to generic rank. The differences between *Ochrotomys* and other forms assigned to

Peromyscus are approximately of the order of those distinguishing the genera *Peromyscus* and *Baiomys*. Therefore, *Ochrotomys* is very questionably retained as a subgenus of *Peromyscus*.

GENUS BAIOMYS

This genus is represented in my material by specimens of *Baiomys taylori subater*. The baculum of *Baiomys* is shown in figure 2, E. It differs in many important respects from the baculum of any of the species of *Peromyscus* at hand. The base of the baculum is not nearly so broad in relation to the length of the shaft as in *Peromyscus*. Thin wings anterior to the base project dorso-laterally, forming a channel between them. The tip of the baculum is considerably enlarged, a condition that is not approached in *Peromyscus*. The most slender part of the shaft lies approximately two-thirds of the way from the base to the tip, while in *Peromyscus* the most slender part is at or very near the tip. The greatest width (across the wings) is contained 6.2 times in the length of the baculum. The length of the baculum is less in proportion to the animal's body length than in any *Peromyscus* except *nuttalli* of the subgenus *Ochrotomys*. The length of the baculum is contained in the animal's body length 20.3 times, as compared with 24.2 times in *nuttalli*.

In brief, the baculum of *Baiomys* shows important qualitative differences from the bacula of mice of the genus *Peromyscus*. Furthermore, it is proportionately much smaller than the baculum of any *Peromyscus* except the subgenus *Ochrotomys*.

GENUS ONYCHOMYS

The baculum of *Onychomys leucogaster ruidosae* has been measured and figured for comparison with *Peromyscus* and *Baiomys* (fig. 2, C). It is very different from the *Peromyscus* bacula. The shaft is much flattened dorso-ventrally, instead of being more or less rounded or ellipsoidal in cross-section as in *Peromyscus*. The basal portion, on the other hand, is globular in contrast to the flattened base in *Peromyscus*. In *Onychomys* the greatest basal width is contained 5.7 times in the length of the baculum. This structure is relatively short in proportion to the body length of the mouse. No body measurement of the specimen figured was made. However, the mean body length of 21 individuals of this species and subspecies as recorded by Hollister (1914: 449) is 110 millimeters. The length of the baculum of my specimen is contained 19 times in this mean body length. This gives a rough indication of the relatively short length of the baculum in *Onychomys*.

GENUS REITHRODONTOMYS

The baculum of *Reithrodontomys humulis merriami* has been measured and figured for comparison with *Peromyscus* and *Baiomys* (fig. 2, D). In this species, the baculum is a very slender rod with a relatively small base. The shaft is moderately curved dorso-ventrally. It is proportionately much elongated, for the greatest basal width is contained 13.5 times in the length of the baculum.

The length is greater in proportion to the width of the base than in any of the three other genera here compared. The length of the baculum is contained 11.8 times in the animal's body length. Thus the relation of length of baculum to length of body is approximately the same as in several of the *Peromyscus*.

INTER-GENERIC RELATIONSHIPS

Much difference of opinion has existed as to whether *Baiomys* should stand as a full genus or be considered a subgenus of *Peromyscus*. True (1894: 958) erected *Baiomys* as a subgenus of *Sitomys* (now *Peromyscus*) on the basis of certain skeletal and external differences. Mearns (1907: 381) raised *Baiomys* to generic rank. Osgood (1909: 252) however classified it as a subgenus of *Peromyscus*. Then Miller (1912: 136) restored *Baiomys* to generic status.

The characters of the baculum convincingly corroborate the other characters that have been used to distinguish *Baiomys* as a separate genus. Its small and relatively complex baculum is entirely different from anything found in any of the four subgenera of *Peromyscus* at hand. The baculum of *Baiomys* differs equally as much from the *Peromyscus* bacula as does that of *Onychomys*. It differs more from *Peromyscus* than does the baculum of *Reithrodontomys*.

Baiomys, in addition to its skeletal and morphological differences from *Peromyscus*, differs strikingly in habits (Blair, 1941). Captive males assist the females in caring for the young, a thing that is unknown in *Peromyscus*. *Baiomys* utters a high-pitched call note such as has been observed in *Onychomys* (Bailey, 1931: 137) and in *Reithrodontomys* (Svihla, 1930: 53), but never observed in *Peromyscus*. In nature, *Baiomys*, unlike any *Peromyscus* of which I know, makes and follows tiny microtine-like runways. Thus in its habits as well as structurally *Baiomys* is very different from the mice of the genus *Peromyscus*.

SUMMARY

In *Peromyscus*, the subgenera *Peromyscus*, *Haplomylomys*, *Podomys*, and *Ochrotomys* are easily distinguished by their characteristic types of bacula. In the subgenus *Peromyscus*, the *maniculatus* and *leucopus* species groups have a baculum of a similar type; the *boylii* and *truei* have one of another general type. In the subgenus *Haplomylomys*, the species *crinitus* and *eremicus* have similar bacula and *californicus* has a baculum of a different type.

The subgenera *Peromyscus*, *Haplomylomys*, and *Podomys* have bacula that represent modifications of the same general type. *Ochrotomys*, on the other hand, has a very different baculum, which, in conjunction with its other skeletal and morphological peculiarities, makes doubtful the retention of *Ochrotomys* as a subgenus of *Peromyscus*. Possibly it should be raised to generic rank.

The unique baculum of *Baiomys* corroborates previously described skeletal and morphological differences that have led to its recognition as a full genus, rather than as a subgenus of *Peromyscus*. The baculum of *Baiomys* differs as much from the bacula of *Peromyscus* as does that of *Onychomys* and more than does that of *Reithrodontomys*.

LITERATURE CITED

BAILEY, VERNON. 1931. Mammals of New Mexico. North Amer. Fauna no. 53, pp. 1–412, 22 pls., 58 text figs.

BLAIR, W. FRANK. 1941. Observations on the life history of *Baiomys taylori subater*. Jour. Mamm., vol. 22, no. 4, pp. 378–383.

HOLLISTER, NED. 1914. A systematic account of the grasshopper mice. Proc. U. S. Nat. Mus., vol. 47, pp. 427–489, 1 pl., 3 text figs.

MEARNS, E. A. 1907. Mammals of the Mexican Boundary of the United States. Bull. U. S. Nat. Mus., no. 56, pp. i–xv, 1–530, 13 pls., 126 text figs.

MILLER, GERRIT S. 1912. List of North American land mammals in the United States National Museum, 1911. Bull. U. S. Nat. Mus., 79: pp. i–xiv, 1–455.

OSGOOD, WILFRED H. 1909. Revision of the mice of the American genus Peromyscus. North Amer. Fauna no. 28, pp. 1–285, 8 pls., 12 text figs.

SVIHLA, RUTH DOWELL. 1930. Notes on the golden harvest mouse. Jour. Mamm. vol. 11, pp. 53–54.

TRUE, FREDERICK W. 1894. On the relationships of Taylor's mouse, Sitomys taylori. Proc. U. S. Nat. Mus., vol. 16, pp. 757–758.

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A SUMMARY OF RECOGNIZABLE SPECIES OF TONATIA, WITH DESCRIPTIONS OF TWO NEW SPECIES

BY GEORGE G. GOODWIN

The discovery of *Tonatia bidens* in Costa Rica and *T. amblyotis* in British Honduras, both places being widely separated from the type localities, has led me to make a brief review of the material now available in American collections. This study has brought out some interesting facts and an analysis of the specimens seems of sufficient importance to be recorded.

Acknowledgment for the loan of material is due the Field Museum of Natural History, the U. S. National Museum, the Carnegie Museum and the Museum of Comparative Zoology.

GENUS TONATIA GRAY

1823 *Vampyrus* Spix, Sim. Vesp. Bras., p. 65 (*bidens*).
1827 *Tonatia* Gray, Griffith's Cuvier Animal Kingdom V, p. 71 (*Vampyrus bidens* Spix).
1838 *Phyllostoma* Gray, Mag. Zool. Bot. 2, p. 488 (*childreni*).
1847 *Lophostoma* d'Orbigny, Voy. dans l'Amerique merid, p. 11 (*sylvicolum*).
1855 *Tylostoma* Gervais, Exped. de Castelnau (*bidens*).
1878 *Lophostoma* Dobson, Cat. Chirop. Brit. Mus. p. 473.
1898 *Tonatia* Palmer, Proc. Biol. Soc. Wash., XII, p. 110.
1910 *Chrotopterus* Allen, Bull. Amer. Mus. Nat. Hist., XXVIII, p. 147 (*carrikeri*).

Type Species.—*Vampyrus bidens* Spix.

Range.—Tropical America from the Atlantic Coast in Brazil west to Bolivia and north to British Honduras.

Characters.—Dental formula:

$$\frac{-\,2\;3.\;1.\;-\,-\;3\;4\;5\;6\;7}{1\;-\,-.\;1.\;-\,2\;3\;4\;5\;6\;7};\ i\ \frac{2-2}{1-1};\ c\ \frac{1-1}{1-1};\ pm\ \frac{2-2}{3-3};\ m\ \frac{3-3}{3-3} = 32.$$

Tonatia is a large-eared bat with a well developed noseleaf and short tail. In general, external characters of small species are similar to *Micronycteris*. The teeth throughout are stronger than those of *Micronycteris*, but their structure is essentially the same, except that the anterior upper premolar is broader than long and the middle lower premolar is minute and crowded between the anterior and posterior teeth.

Tonatia bidens Spix

Vampyrus bidens Spix, 1823, Sim. Vesp. Bras., p. 65.

Phyllostoma childreni Gray, 1838, Mag. Zool. Bot., 2, p. 488.

Tylostoma bidens Gervais, 1855, Expéd. de Castelnau, p. 49.

Lophostoma bidens Peters, 1865, Monatsb. Akad. Berlin, p. 509; Dobson, 1878, Cat. Chiropt., p. 473; Trouessart, 1897, Cat. Mamm., p. 153; Lyon, 1901, Proc. U. S. Nat. Mus., p. 154.

Tonatia bidens Palmer, 1898, Proc. Biol. Soc. Wash., p. 111; Sanborn, 1936, Zool. Ser. Field Mus. Nat. Hist., XX, no. 13, p. 96.

Type locality.—Rio San Francisco, Bahia, Brazil.

Range.—From Bahia, Brazil, west to Peru and north, east of the Andes to the Guianas, Venezuela, and north in Central America to Costa Rica.

Characters.—Size large, ears short and broad, proximal half of forearm well haired; base of thumb and uppersides of feet hairy. Color of upperparts varying from ochraceous tawny to blackish Mummy brown, base of hairs behind ears and on neck more or less white; underparts paler and grayer than back and washed with pale buff.

Skull large and massive, rostrum broad, flat and not constricted in orbital region; braincase low and broad; superior outline evenly elevated from front of nasals and without depression in orbital region; palate narrow; toothrow only slightly converging anteriorly; sagittal crest low and fine.

Measurements, five females and one male from Amazon basin, one male from Venezuela and six females and two males from Costa Rica: Forearm, 55–59 mm; third metacarpal 46–48.5, first phalanx, 18.7–21, second phalanx, 21.7–23.6, fourth digit metacarpal, 46.5–50, first phalanx 14.5–18, second phalanx 15.6–15.7; fifth digit metacarpal, 47.5–51, first phalanx, 15.3–18.8, second phalanx, 13.7–14; ear, 24.7–25.4; hind foot in dry skin, 15–17.5. Skull measurements (Amazon basin, Venezuela, and Costa Rica, respectively): Greatest length, 27–28.5, 28.8, 27.7–29.5; condylobasal length, 24–24.5, 25, 24.5–25; zygomatic width, 13.5–14, 14.4, 14.2–15; postorbital width, 5.3–5.5, 5.8, 5.3–6; width of braincase, 10–10.9, 10.5, 10–10.8; width across upper canines, 5.5–6, 5.7, 5.6–6; width across m^2 – m^2, 8.3–8.6, 8.8, 7.9–8.5; length of upper toothrow, 9.3–9.8, 10, 9.8–10.2.

Tonatia bidens varies little in size and character throughout most of its range in South America. One old male from the Rio Tocuyo, Venezuela, however is a large bodied individual with thick pelage, very broad ears, extensively hairy forearm and feet. Externally it is strikingly different from the rest of the South American specimens. The skull is also larger than the average but cranial characters and the size of the teeth are about the same as in typical *bidens*.

A series of eight specimens from Costa Rica are the maximum in size of the available material, but, with this exception, they are no different from eastern Brazilian specimens.

Specimens examined.—**Costa Rica:** Palmar (Pacific, 8 A.M.N.H. **Peru:** Alto Ucayali Lagarto, 4 A.M.N.H. **Venezuela:** Rio Tocuyo, 1 A.M.N.H. **British Guiana:** Kartabo, 1 A.M.N.H. **Brazil:** Rio Tocantins, Ilna do Taiuna, 5 A.M.N.H.; Rio Tapajoz, Sanatarem, 1 A.M.N.H.; Matto Grosso, Urucum de Corumba, 4 Field Mus. (3 in spirits).

Tonatia nicaraguae new species

Type.—No. 41184, Amer. Mus. Nat. Hist.; female adult, in spirits; Kanawa Creek, near Cukra, north of Bluefields, Nicaragua, altitude 100 feet; collected by Halter and Mannhardt, August 7, 1916. The type is the only known specimen.

Characters.—A small, dark-colored *Tonatia* with large ears connected by a low band across forehead; lower lip with a naked V broken into wart-like protuberances; noseleaf, broad and attenuated to a sharp point and not extended below nostrils as a separate leaf; forearm finely haired on basal half. Tail, short and apparently not perforating the very broad interfemoral membrane; forearm, about 32 mm. General color of upperparts mummy brown, the hairs broadly white at base; underparts, light drab. Skull: small; rostrum relatively broad, parallel-sided and not constricted in orbital region; braincase low, rounded and without sagittal crest, superior outline evenly elevated from nasals and without depression in orbital region; palate narrow and not perceptibly converging anteriorly; posterior border of palate ending on a line across front of last molar; middle lower premolar minute but completely separating anterior and posterior teeth.

Measurements.—Head and body, 42.5 mm; tail, 6; hind foot, 10; ear, from notch, 17.5; forearm, 32; third digit metacarpal, 24.8: first phalanx, 10.5; second phalanx, 12.3; fourth digit metacarpal, 24.8: first phalanx, 10.5; second phalanx, 9.2; fifth digit metacarpal, 27.5: first phalanx, 11.5, second phalanx, 9.5. Skull: greatest length, 17.9; interorbital width, 3.4; width of braincase, 7.8; width across canines, 3.4; $pm^1 - pm^2$, 3.3; $m^2 - m^2$, 5.4; length of upper toothrow, 6.5; length of lower toothrow, 7.2.

Remarks.—*Tonatia nicaraguae* is about the size of *Micronycteris megalotis mexicana* and specimens in spirits may be confused with the latter. It can be distinguished, however, by the wart-like outgrowths on the lower lip instead of a simple V and by the undeveloped lower portion of the noseleaf. *T. nicaraguae* is smaller than *T. minuta*, with smaller teeth, relatively longer palate, broader interorbital region, lower and more rounded braincase, and no sagittal crest, which is well developed in the latter.

Tonatia minuta new species

Type.—No. 71619, Amer. Mus. Nat. Hist.; adult ♂, skin and skull in good condition; Boca Curaray Ecuador; collector, Olalla Brothers; December 4, 1926.

Characters.—Smallest of the known species of *Tonatia*; forearm about 34 mm, finely haired from proximal end for about half its length. General color of upperparts Mummy brown, becoming darker on cheeks and around face, fur buffy white from base for about half its length. Underparts snuff brown, the hairs lightly tipped with pale buff.

Skull small, braincase relatively narrow and high, elevated above rostrum but not so abruptly as in *venezuelae*; interorbital region constricted; palate short and ending in front of a line drawn across the border of the second upper molars.

Measurements, type and two females in parentheses (after dampening): Forearm, 34 mm (— —); third digit metacarpal, 27.3 (27.4, 27), first phalanx, 12.4 (12, 12), second phalanx, 14 (13.5, 14.5); fourth digit metacarpal, 28.5 (28.5, 28), first phalanx, 12.5 (12.6, 12.5), second phalanx, 11.5 (11.5, 10.5); fifth digit metacarpal, 30.5 (30.5, 29.2), first phalanx, 12.8 (13, 12.5), second phalanx, 11 (10.6, 9.6); ear from notch, 19.2 (20, 18.5); foot from back of calcar to end of claws, 11 (11, 11). Skull: Greatest length, 18.7 (18.6, 19); condylobasal length, 16.2 (16, 16.2); median palatal length, 8.4 (8, 8.2); interorbital width, 3 (3, 3); zygomatic width, 9 (8.8, 9); mastoid width, 8.9 (8.7, 9); width of braincase, 7.7 (7.5, 8.2); greatest width across canines, 4 (3.8, 3.6); width across $pm^1 - pm^1$, 3.6 (3.7, 3.5); width across $m^2 - m^2$, 6.1 (6, 5.8); length of upper toothrow, 6.9 (6.7, 6.6); length of lower toothrow, 7.5 (7.5, 7.4).

Tonatia minuta needs no comparison with *venezuelae*. It is smaller than *brasiliense*, with smaller ears, narrower and higher braincase, longer palate and more slender rostrum.

Specimens examined.—**Ecuador:** Boca Curaray 6 (including type).

Tonatia brasiliense Peters

Tylostoma brasiliense Gray MS.

Lophostoma brasiliense Peters, 1866, MB. Akad. Berlin, p. 674; Dobson, 1878, Cat. Chiropt., p. 474; Lyon, 1902, Proc. U. S. Nat. Mus., XXIV, p. 154.

Type locality.—Bahia, Brazil.

Range.—Eastern Brazil, limits of range unknown.

Characters (Based on two specimens from the Rio Tapajoz).—Size small, forearm 36 to

38 mm; smaller than *venezuelae* and slightly larger than *minuta*. General color Prout's brown, grading to Mummy brown around face, base of fur creamy white, underparts paler than back and lightly washed with pale buff.

Skull small, short; braincase relatively low and rounded; sagittal crest finely developed; rostrum broad but constricted in postorbital region; palate short.

Measurements of an adult male and female from the Rio Tapajoz (after dampening), Peters measurements of the type in parentheses: Forearm 36.2 mm, 37.2 (38); third digit metacarpal, 28.5, 28.5 (29), first phalanx, 13.5, 13 (12.8), second phalanx, 14.2, 14.5 (14); fourth digit metacarpal, 30, 29.5 (29.3), first phalanx, 13.5, 12.5 (12.3), second phalanx, 12.5, 11.7 (11.5); fifth digit metacarpal, 31, 30.5 (31.8), first phalanx, 13.5, 13.2 (12), second phalanx, 11.5, 10.8 (10.9); foot, 11.5, 11.5 (11.5); ear from notch, 20, 21 (21.5). Skull: Greatest length, 19.5, 19.5; condylobasal length, 16.8, 17; palatal length, 8.1, 8.2; interorbital breadth, 3.1, 3.1; zygomatic breadth, 9.3, 9.5; mastoid width, 9.1, 9.4; breadth of braincase, 8.1, 8; width across upper canines (at middle of shaft), 3.6, 3.5 (3.5); width across $pm^1 - pm^1$, 3.7, 3.7; width across $m^2 - m^2$, 6.3, 6.2; length of upper toothrow, 7, 6.9; length of lower toothrow, 7.5, 7.5.

Tonatia brasiliense is apparently related to *T. minuta* but differs in larger size, relatively broader skull, lower and more rounded braincase, and shorter palate. Two specimens from the Rio Tapajoz are here provisionally considered typical until a better description of the type can be obtained. They agree closely with the measurements given in Peters description.

Specimens examined.—**Brazil:** Rio Tapajoz, Igarape, Amorin, 2 A.M.N.H.

Tonatia venezuelae Lyon

Lophostoma venezuelae Lyon, 1902, Proc. U. S. Nat. Mus., XXIV, p. 154.

Type locality.—Macuto, Venezuela.

Range.—Known from Macuto and San Estaban, Venezuela; Aripo, Trinidad.

Characters.—Size small; forearm 38 to 40 mm; pelage moderately long, about Isabella color, base of fur whitish; underparts paler than back. Skull rather small, constricted in postorbital region, braincase high and elevated behind rostrum; sagittal crest well developed; palate moderately short.

Measurements of an adult male from Macuto and a female from San Estaban (spirit specimens): Forearm, 40.5, 38.5; third digit metacarpal, 31.8, 30.5, first phalanx, 14.2, 13.8, second phalanx, 16.7, 15.7; fourth digit metacarpal, 32.5, 30.5, first phalanx, 15, 13.5, second phalanx, 13.8, 12; fifth digit metacarpal, 33.8, 32.3, first phalanx, 15.5, 14.3, second phalanx, 13, 12.4; ear, 21.5, 20.2; foot from back of calcar, 11.6, 11.5 Skull (type in parentheses): Greatest length, 21.6, 21.1 (21.2); condylobasal length, 18.5, 17.5 (—); palatal length, 9.5, 9.5 (9); interorbital width, 3.3, 3.1 (3.2); zygomatic width, 10.5, 10.4 (10.4); mastoid width, 10.4, 10 (—); width of braincase, 8.3, 8.4 (8.4); width across upper canines, 4.6, 4.2 (—); width across pm^1–pm^1, 4.4, 4.1 (4.4); width across, m^2–m^2 6.7, 6.6 (6.8); length of upper toothrow, 7.7, 7.4 (7.4); length of lower toothrow, 8.5, 8.2 (8.4).

Tonatia venezuelae is readily recognized by its small size, high braincase and narrow interorbital constriction; it is appreciably larger than *minuta* and *brasiliense*.

Specimens examined.—**Venezuela:** Macuto 3 (in spirits) U.S.N.M.; San Estaban 1 (in spirits) U.S.N.M.

Tonatia carrikeri Allen

Chrotopterus carrikeri Allen, 1910, Bull. Amer. Mus. Nat. Hist., XXVIII, art. 12, p. 147.

Type locality.—Rio Mocho, Venezuela.

Range.—Known only from the type locality.

Characters.—Size medium, forearm 46 to 47 mm. General color of upperparts Mummy brown, the hairs finely tipped with pale buff, extreme base of fur white; underparts pure white to roots of hair except on chin and sides of abdomen. Skull, medium in size, constricted in postorbital region, palate short and ending on a line across middle of second molars,

sagittal crest barely indicated, superior outline of skull evenly elevated from nasals and only slightly concave in orbital region; second lower premolars relatively large and separating the first and third premolars.

Measurements of an adult male and female from Rio Mocho (after dampening): Forearm, 47, 47.5 mm; third digit metacarpal, 39.5, 39.2, first phalanx, 16.3, 16, second phalanx, 19.2, 19; fourth digit metacarpal, 41, 40.5, first phalanx, 15, 15.3, second phalanx, 14.6, 14.6; fifth digit metacarpal, 43.3, 42.8, first phalanx, 16.4, 16.2, second phalanx, 12.7, 12.4; ear from notch, 25.5, 22.5; hind foot, from back of calcar to end of claws, 14.7, 14.5. Skull: Greatest length, 25.9, 24.9; condylo-incisive length, 22.2, 21; palatal length, 10.5, 10; zygomatic width, 3.7, 3.5; postorbital width, 3.7, 3.5; mastoid width, 12.8, 11.3; width of braincase, 9.8, 9.5; width across upper canines, 5.2, 4.5; width across pm^1–pm^1 4.7, 4.2; width across m^2–m^2 8.1, 7.5; length of upper toothrow 8.7, 8.3.

Tonatia carrikeri is readily recognized by its medium size, short palate and its unique coloration. While carrying the specializations of the small species to extreme it has retained certain characteristics of both *bidens* and *ambylotis*.

Specimens examined.—**Venezuela:** Rio Mocho, 7 A.M.N.H.

Tonatia amblyotis Wagner

Phyllostoma amblyotis (Natt., MS.) Wagner, 1843, Arch. Naturg. p. 365.

Lophostoma sylvicolum, d'Orbigny, 1847; Voy. dans l'Amerique mérid, p. 11; Gervais, 1855, Expéd du Comte de Castelnau, Zologie, p. 48, pl. X, fig. 6.

Lophostoma amblyotis, Peters, 1865 MB. Akad. Berlin, p. 509; Dobson, 1878, Cat. Chiropt. p. 475.

Tonatia amblyotis Thomas, 1902, Ann. Mag. Nat. Hist., (7), X, p. 54.

Chrotopterus colombianus Anthony, 1920, Jour. Mamm., I, no. 2, p. 84.

Tonatia amblyotis Sanborn, 1936, Zool. Ser. Field Mus. Nat. Hist. XX, no. 13, p. 96.

Type locality.—Matto Grosso, Brazil.

Range.—From Matto Grosso, Brazil, west and north through Bolivia, Peru, Ecuador, Colombia, Panama and north to British Honduras.

Characters.—Size large, forearm 50 to 54 mm. General color varying from Mars brown to Mummy brown, the hairs lightly tipped with pale buff, base of hairs broadly white behind ears and back of neck; underparts grayer than back with a white area or collar on throat and underside of neck well developed in most specimens, but grayish and not very different from rest of underparts in some individuals. Skull narrow with a high braincase, superior outline elevated in interorbital region; rostrum relatively long and notably constricted in postorbital region; posterior border of palate on a line across front of third molars; sagittal crest moderately developed.

Measurements.—Forearm 50–55 mm; third digit metacarpal, 39.3–46.1, first phalanx, 18–18.6, second phalanx, 19–19.8; fourth digit metacarpal, 42.4–48.4, first phalanx, 16.5–17, second phalanx, 17.8–18.1; fifth digit metacarpal, 44–51.1, first phalanx, 16.6–17.6, second phalanx, 14.5–15.1; hind foot, 15.5, 16.6; ear from notch, 28–31. Skull (British Honduras specimen in parentheses): Greatest length, ♂, 26.8–28 (25.1), ♀, 25.2–26.5; condylobasal length, ♂, 23.2–24.1 (21), ♀, 21.6–22.8; palatal length, ♂, 12.5–12.8 (11.5), ♀, 11.2–12; postorbital width, ♂, 3–5 (3.8), ♀, 4–5; zygomatic width, ♂, 13.2–14.2 (12.2), ♀ 12.3–13; mastoid width, ♂, 13.6–14.1 (12.2), ♀, 12–13.1; width of braincase, ♂, 10–10.5 (9.5), ♀, 10–10.8; width across upper canines, ♂, 5.8–6.5 (5.6), ♀, 5.3–5.8; width across pm^1–pm^1 5.4–6.5 (5), ♀, 5.2–5.5; width across m^2–m^2, ♂, 8.5–9.1 (7.5), ♀, 8.5–8.8; length of upper toothrow, ♂, 9.8–10 (8.7), ♀, 9.5–9.7.

Tonatia amblyotis varies little in size and cranial characters throughout its known range in South America; individual variation in large series is not unusual, especially in color. Central and northern Columbian specimens are average in size but the light collar that is more or less pure white in most Oriente specimens is dull grayish and not much different from the rest of the underparts. One individual from British Honduras is relatively small in size but there are no other characters separating it from typical *amblyotis*. Topotypes

from Matto Grosso are not available in American collections. Specimens from Buena Vista, Bolivia are probably typical. This, however, is near the type locality for *L. sylvicolum* d'Orbigny which is in the foothills of the Bolivian Andes in the county of Juracares between the headwaters of the Secure and Isibara. Thomas recognized *sylvicolum* as having shorter ears (25 x 21 mm) and larger feet (20–21 mm from base of calcar to end of claws) than *loephotis* and *amblyotis*. Four Bolivian specimens examined have normal ears (31 x 21 mm after dampening) and the average foot length for typical *amblyotis*. D'Orbigny's unusual foot measurements correspond closely with the length of the calcar and the figure of the skull shows all the characters referable to *amblyotis*.

Specimens examined.—**Bolivia:** Rio Dolores, Prov. del Sara, 1 Carnegie Mus., 1 Field Mus.; Buena Vista, 1 Carnegie Mus.; Rio Surutu, Santa Cruz, 2 Carnegie Mus. **Peru:** Huanaco, Tingo Maria, 1 Field Mus.; Vitoc Valley, Prov. Tarma, Dept. Junin, 3 (in spirits) Field Mus.; Lagarto Alto Ucayali, 4 A.M.N.H.; Sarayacu R. Ucayali, 1 A.M.N.H.; Apayacu, 1 A.M.N.H.; Pto. Indiana, R. Amazonas, 3 A.M.N.H.; Orosa R. Amazonas, 3 A.M.N.H.; Mouth of Santiago River, 2 A.M.N.H.; Pto. Melendez, 2 A.M.N.H. **Ecuador:** Rio Bobonazo, 4 Field Mus., 1 U.S.N.M.; Oriente Rio Capihuari, 3 Field Mus., 1 U.S.N.M.; Rio Suno, 1 Field Mus.; Oriente Rio Pindo Yaco, 2 Field Mus.; Oriente Rio Pastaza, 3 Field Mus., Boca R. Curaray, 18 A.M.N.H. **Colombia:** Rio Waupes Frente a Tãhuopunto, 8 A.M.N.H.; Espinal, 1 Field Mus.; Bonda, 1 A.M.N.H.; Guaicaramo, 1 U.S.N.M.; Purificacion, 1 A.M.N.H.; Rio Quatequia, near Bogota, 1 A.M.N.H.; Guaicaramo, 1 M.C.Z.; Natagaima, 1 M.C.Z. **Panama:** Bogava Chiriqui, 1 Brit. Mus., Rio Esnapa, 1 (in spirits) M.C.Z. **British Honduras:** Freetown Sittee River, 1 (in spirits) Carnegie Mus.

Tonatia loephotis Thomas

Tonatia loephotis Thomas, 1910, Ann. Mag. Nat. Hist., (8), VI, p. 184.

Type locality.—River Supinaan, tributary of the lower Essequibo, British Guiana.

Range.—Coast region of the Guianas and the Lower Amazon Basin in Brazil.

Characters.—Largest of the known species of the long-eared *Tonatia*; forearm 53 to 59 mm, similar in general characters to *amblyotis* but larger with larger skull, more massive teeth and accentuated sagittal crest. General color in fresh pelage dark Mummy brown to base of hairs over most of back, finely washed with pale buff; base of hairs on back of neck and behind ears white but more or less concealed by the broad dark tips of hairs; underside of neck white, this color extending over most of underparts in some individuals and almost imperceptible in others; rest of underparts paler and grayer than back.

Measurements, adult female and male, lower Amazon basin (dry skins): Forearm 53, 59; third digit metacarpal, 43, 49.5, first phalanx, 20.5, 19.5, second phalanx, 21.6, 24.5; fourth digit metacarpal, 44.5, 50.5, first phalanx, 17.5, 19.5, second phalanx, 17, 18.4; fifth digit metacarpal, 46.5, 53.8, first phalanx, 18.3, 19, second phalanx, 15.5, 17; hind foot, 17, 18.5; ear from notch (dampened), 29, 31.5. Skull (16 specimens): Greatest length, ♂, 27.5–29.5, ♀, 27.1–27.9; condylobasal length, ♂, 24.2–24.9, ♀, 23.3–24; palatal length, ♂, 12.8–13.4, ♀, 12.3–12.7; zygomatic breadth, ♂, 13.5–14.7, ♀, 13–14; postorbital constriction, ♂, 4–4.5, ♀, 4–4.3; width across canines, ♂, 6–6.6, ♀, 5.5–6; width across pm^1–pm^1, ♂, 5.6–6.1, ♀, 5.2–6.1; width across m^3–m^3, ♂, 9–9.2, ♀, 8.5–8.9; mastoid width, ♂, 14–14.8, ♀, 13.2–13.5; width of braincase, ♂, 10.6–11, ♀, 10.3–11; length of upper toothrow, ♂, 9.7–10.6, ♀ 9.5–10.2.

Tonatia loephotis is a separable species, characterized by its large size, massive teeth and accentuated sagittal crest. It belongs in the *amblyotis* group, having the interorbital region constricted and the crown elevated above rostrum; palate normal.

Specimens examined.—**Brazil:** Rio Zingu, Porto de Moz, 1 A.M.N.H.; Rio Tapajoz, Limontuba, 11 A.M.N.H.; Ynajalubu, 9 A.M.N.H.; Limoal, 5 A.M.N.H.; Igarape Amorin, 1 A.M.N.H.; Tauary, 1 A.M.N.H.; Boim, 5 M.C.Z. Rio Majary: Recreio, 1 A.M.N.H. Rio Tocantins: Ilha do Taiune, 42 A.M.N.H.; Baião, 5 A.M.N.H.; Mocajuba, 3 A.M.N.H.; Cameta, 2 A.M.N.H., 4 M.C.Z.

American Museum of Natural History, New York, N. Y.

GENERAL NOTES

A SUPPOSED ADAPTATION AGAINST SUN STROKE IN AFRICAN DIURNAL RATS

In preparing skulls of collections received from Mr. G. H. E. Hopkins, Senior Entomologist (Medical), Kampala, Uganda, it was noticed that the periosteum covering the roof of the skull was heavily black-pigmented in the rats of the genera *Arvicanthis*, *Rhabdomys*, *Lemniscomys*, and *Pelomys* (a closely related group), while in other rats, chiefly nocturnal in habits, no pigment was seen. The uncleaned skulls (the periosteum is destroyed by most methods of preparation) of the genera mentioned could be separated from those of other Muridae by the character of pigmentation alone. The diurnal habits of the arvicanthine rats have been recorded in several papers (Roosevelt and Heller, 1910, African Game Trails, Appendix B, p. 478 (542 in another edition); Shortridge, 1934, Mammals of South West Africa, vol. 1, pp. 273, 275, 278–279) and these are corroborated by Mr. T. Donald Carter, who has collected many specimens of the four genera (personal communication). The top of the skull in rats is covered only by the skin and short hair, and the bone is thin, so less protection is afforded the brain by these structures than is usual in mammals.

It appears that the black pigment covering the skull is an adaptation to protect the brain of these diurnal forms from the rays of the tropical sun. It would be interesting to find this adaptation in other diurnal mammals from regions where there is much powerful sunlight and to learn whether rats of this group show periosteal pigment in the Temperate Zone of South Africa.—John Eric Hill, *The American Museum of Natural History, New York.*

CYCLES OF VIRGINIA VOLES

During the months June–September, 1940, a part-time study of the small mammals in and around Albemarle County, Virginia, was carried out. As a result of extensive field work, observations on the populations of two species of considerable economic importance for this orchard area were obtained.

Lewis (Jour. Mamm. vol. 19, pp. 163–170) reported having taken but six meadow mice (*Microtus pennsylvanicus pennsylvanicus*) in Amelia County in three months trapping beginning January 1, 1937, but, "by December, 1938 they swarmed in all suitable places," and "now, in the spring of 1940, they seem to be decreasing in numbers." The present study extending over four summer months yielded none of these voles in Albemarle County and "signs" were entirely lacking in orchards which had been hard hit in the two previous years. M. L. Bobb (personal communication) reports a slight increase now, in the spring of 1941. These observations indicate a four year cycle for the meadow vole in this general locality.

The pine vole (*Pitymys pinetorum scalopsoides*), another species of much concern to local orchardmen, was at its peak of abundance during the same years (1938, 1939) as the meadow vole, and it also reached an apparent low with this species in the summer and fall of 1940. A gradual recovery of this species also seems to be beginning at present which would indicate a correspondence of cycles for the pine vole and meadow vole in this area. Hamilton (Jour. Mamm. vol. 19, pp. 163–170) has reported a similar coincidence of cycles for these two species in New York.—J. P. Linduska, *Game Division Department of Conservation, Lansing, Michigan.*

ON THE OCCURRENCE OF PREGNANCY IN WHITE-TAILED DEER FAWNS

Sofar as we are aware, it is not generally known that female white-tailed deer (*Odocoileus virginianus*) breed in their first year. During the course of an investigation of the factors controlling the abundance of this species in New York State, pregnancy among fawns during their first winter following birth has come to our attention.

Of 62 doe fawns from various parts of the State, exclusive of the Adirondack region, collected and autopsied between December 1, 1939 and June 30, 1940, 23 were pregnant. Two others collected in January of the same year had corpus lutea, indicating ovulation and the occurrence of "heat," though no embryos were visible in the uterus. Thus 25, or 40.3 percent, had attained sexual maturity during their first year.

Present data indicates that most fawns from adult does are dropped during the latter part of May and the first two weeks of June in New York. Tentative age determinations of the embryos of these pregnant fawns indicate their highest breeding frequency to have been during the month of December, or about one month later than most adults. This would place their ages at from 6 to 7 months at the time of breeding.—E. L. CHEATUM AND GLENN H. MORTON, *New York State Conservation Department, Bureau of Game, Albany, New York.*

NEST AND YOUNG OF THE OLYMPIC DUSKY SHREW

In his review of the genera *Sorex* and *Microsorex* Jackson (1928) states, "Very little is known in regard to the nests and home life of long-tailed shrews. They build nests of grass and leaves under logs, in stumps, and similar situations, but few of these have been found, much less critically studied." He describes a litter of eight *Sorex cinereus haydeni* from Manitoba and mentions also having examined a litter of five *S. longirostris fisheri* from Virginia. Again, writing of *Sorex obscurus obscurus*, Vernon Bailey (1936) says, "Little is known of the young after birth, and few naturalists have ever seen a young shrew." It seems desirable, then, to describe a nest and seven young of *Sorex obscurus setosus* Elliot that were found by my wife, Jane M. Slipp, and me while collecting salamanders in Mount Rainer National Park on July 25, 1937.

The nesting site was at an elevation of about 4,200 feet in upper Canadian Zone timber approximately half way along the short trail between Round Pass and Lake George in the southwestern portion of the park. The forest floor in the vicinity was steep, of easterly to southeasterly exposure, fairly dry, well-lighted, and clear of dense brush.

We had broken open a rotten fir log perhaps 20 inches in diameter when a chorus of faint squeaking notes led us to the nest. In it were three of four tiny brown shrews with eyes still closed, but well able to wriggle and creep about and to protest their disturbance with thin, high, chirping notes. Further search through the wood fragments within a few inches of the nest raised the total to seven, some apparently having sought safety in flight when the nest was threatened.

Nest and young were placed in a collecting can, but circumstances prevented capture of the female for certain identification. The Olympic dusky shrew is, however, by far the commonest form in the park, and practically the only one to be expected at this particular station (Taylor and Shaw, 1927). The habitat was like that of *S. t. trowbridgii* (Jackson, 1928) which, however, is a sooty gray rather than a brown species. Finally the specimens were submitted to Dr. Jackson, who examined them and replied as follows, "You wished to be assured that these were *Sorex obscurus setosus*, and after examining them we believe your determination is correct."

The nest itself was a ball of dry grass about the size of a man's fist, loosely constructed and without a definite central cavity or passage ways; doubtless the occupants merely pushed through wherever they wished. It had been located in a crevice or pocket in the bottom side of the log, and indications of a runway descending from nest to ground by way of a partially buried supporting log were discernible.

During the next three days the young were fed frequently with sweetened milk on a cotton swab, but, although accepting this, sometimes for periods of many seconds, they did not seem to relish it. Feeding was accompanied by soft smacking sounds and occasional sneezes. No attention was paid such insects (flies, etc.) as were offered them. By the end of the third day all had died (see table), and in that time no change was noted in their appearance or behavior. All were preserved, one as a skin and the others in 70 percent alcohol.

Except for their smaller size these specimens appear superficially like adults; the eyes, however, are closed and relatively undeveloped, the teeth are non-functional, being soft and unerupted, and the pelage, though similar in distribution to that of adults, is much shorter and stiffer. Examination of the dentition of one showed the incisors to be comparatively hard and ready to break through the thin covering membrane, the molariform teeth to have prominent though quite soft and fleshy cusps, and the unicuspids to be hardly evident. Color of the skin and alcoholics are as follows: Vibrissae, feet, and ventral surfaces of head, body, and tail whitish grey; dorsal and lateral surfaces pale tobacco brown merging below with the ventral coloration; tail bicolor, dusky-tipped.

Fresh weights were not obtained. When slit, gently squeezed, and dried externally with compressed air, the specimens preserved in alcohol were found to range from 2.08 to 2.46 grams. An approximate correction factor of plus .17 grams was determined experimentally, and the corrected weights appear in the table. Probably the average figure obtained—2.4 grams—is comparable with weights recorded in the field by collectors, such as those of Dixon for 18 specimens of a smaller race, *S. o. obscurus*, which averaged 6.9 (4.8–8.7) grams (Jackson, 1928). Measurements appearing in the table are all from alcoholics excepting those of no. M16, which were taken before skinning. Jackson (*op. cit.*) gives the following measurements of adult specimens of *S. o. setosus*: Average of 3 adult males from Quinault Lake, Wash., 125.3 mm—59.7—13.7; average of 4 adult females from Mount Vernon, Wash., 123.3—56.8—14. Comparing the above with the tabulated averages it is seen that the measurements of the young are approximately $\frac{2}{3}$, and the weights nearer $\frac{1}{3}$, those of adults of the same species.

NOS.	CAPTIVITY DAYS	LENGTH MM	TAIL MM	FOOT MM	WEIGHT GRAMS
M16	3	86.0	35.0	11.0	
M17	2	84.1	35.9	11.1	2.37
M18	1	81.5	34.3	11.0	2.63
M19	2	78.0	34.1	10.7	2.36
M20	3	79.6	35.5	10.6	2.34
M21	3	82.6	35.8	11.1	2.25
M22	3	84.8	36.8	11.0	2.37
Averages....		82.37	35.34	10.93	2.39

LITERATURE CITED

BAILEY, VERNON. 1936. The mammals and life zones of Oregon. N. Amer. Fauna, no. 55, pp. 1–416.

JACKSON, HARTLEY, H. T. 1928. A taxonomic review of the American long-tailed shrews (Genera Sorex and Microsorex). N. Amer. Fauna, no. 51, pp. 1–238.

TAYLOR, W. P. AND SHAW, W. T. 1927. Mammals and birds of Mount Rainier National Park. Dept. Int., Nat. Park Serv., pp. 1–249.

JOHN W. SLIPP, *Dept. of Botany, University of Washington, Seattle, Wash.*

INSECT FEEDING BY THE HOUSE MOUSE

That many of our common rodent species may have a positive value to agriculture and forestry is a subject not often appreciated. Hamilton (Jour. Forestry, vol. 38, pp. 468–473) has recently brought to attention the importance of small mammals as a controlling agent of forest insects, and points out the paucity of published information relating to the the insectivorous habits of many of our common mouse species. The following observation

of a specific instance of insect feeding by the house mouse (*Mus musculus*) was made in the summers of 1937-38-39, during which time the author was engaged in control work on the pea weevil (*Bruchus pisorum* L.) in the Pacific northwest.

The pea weevil, a widespread pest of peas, overwinters only in the adult stage. Some adults emerge in the fall in which case hibernation takes place under field debris, about buildings, and in a variety of places that offer some degree of protection. Others are observed to overwinter in the pea seed in which case emergence takes place the following spring. The mode of hibernation depends largely on the physical conditions prevailing at the time adulthood is reached in the fall. As a source of individuals for winter laboratory studies it was a usual practice to store quantities of the weevil infested seed in the autumn. It was in this connection in particular that the acute appetite of the house mouse for this particular insect was noted.

Large quantities of this stored "weevily" seed were often found to have been cracked open and the contained weevils eaten. Although the seed itself is undoubtedly palatable to the mice, there was no indication that any part of it was being eaten. Floors and work tables in storage rooms and insectary were repeatedly observed littered with the hollowed pea fragments, indicative of a nights feeding on the unemerged beetles. Similarly, evidences were observed in the field of mice having fed upon weevils present in peas that were shattered out in harvest operations. The extent to which such feeding occurred in the field is difficult of evaluation, but it is pointed out that the situations selected for hibernation by fall emerging adult beetles would also be likely points of concentration for many small mammal species.—J. P. Linduska, *Game Division, Department of Conservation, Lansing, Michigan.*

WEASEL IN POCKET GOPHER BURROW

Recently while trapping pocket gophers, it was the writer's fortune to catch a pocket gopher (*Geomys bursarius*) and a longtail weasel (*Mustela frenata*) at the same set.

Standard pocket gopher traps were used. The main tunnel of the burrow was opened and two traps were set, each about ten inches within the opposite openings and placed in such a manner that the animal would have to come from within the tunnel in order to be caught. This set was made about dusk in the evening and at nine o'clock of the same evening, one trap held a pocket gopher and the other a weasel.—Clifford Florine, *University of Minnesota, St. Paul, Minnesota.*

CACTUS-PAVED RUNWAYS OF *Neotoma albigula*

The following notes are elicited by statements in a review of W. J. Hamilton's "American mammals", which review appeared in this Journal (vol. 22, p. 96).

In July, 1931, I was collecting about 35 miles south of Tucson, Arizona. In a stand of cholla cactus (*Opuntia fulgida*) were runways, about four inches wide, extending 20 feet or so from a pack rat's nest, itself a mass of cholla joints. These runways were evenly covered with the spine-clusters of the cholla, so densely placed that the blunt end of a pencil could not be put down between them. At least three nests in the immediate vicinity possessed similar runways. No animal could enter the nests or use the runways without treading on the cholla spines and traps secured specimens from these houses. I cannot do otherwise than conclude that the pack rats ran over the spines. Claude W. Hibbard, University of Kansas, was with me at the time and agrees with me in the observations and conclusions.

No pack rat examined by me had cactus spines under the skin, such as occur in prairie dogs, rock squirrels, and even skunks in cactus infested regions, nor do the feet of pack rats show signs of injury, in my experience. It is reported, however, that pack rats caught in a trap may become "stuck up" with cactus.

The ability of the pack rat to walk or run with impunity on cactus spines is not my "discovery". Bailey (N. A. Fauna, no. 53, p. 178) reports similar behavior, as do Vorhies

and Taylor in their "Life history . . . of the white-throated wood rat . . . " (1940, Univ. Ariz. Tech. Bull., no. 86 p. 470).—JOHN ERIC HILL, *The American Museum of Natural History, New York, N. Y.*

A CARIBOU ANTLER FROM THE LOWER PENINSULA OF MICHIGAN

In December, 1940, Mr. William F. Spitza presented part of a left antler of a caribou to the University of Michigan Museum. The antler was recovered from a drainage ditch as it was being dug through an old peat bog on the Spitza farm near Minden City, Sanilac County, Michigan. This, as far as I am aware, constitutes the first authentic record of caribou for the mainland of the Lower Peninsula of Michigan. The antler now bears Museum of Zoology number 84108. Previously, caribou have been reported from the Upper Peninsula (from Isle Royale as late as 1905) and from the Beaver Islands (politically part of the Lower Peninsula).

The antler, although incomplete and broken, is in a good state of preservation. There is no evidence of its having been tooled by early man. It seems likely, therefore, that it was dropped naturally and that it was not carried to the site from some more northern locality.—WILLIAM H. BURT, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

TOTAL MELANISM IN MICROTUS FROM MICHIGAN

In the summer of 1940 two melanistic male specimens of *Microtus pennsylvanicus pennsylvanicus* were trapped by me in the state of Michigan. These mice (original nos. 1869, 1878) were taken within twenty feet of each other on August 20 and 21, in a stream-side association of long grass and sedges, close to the waters of the Platte River, 7 miles N. W. of Honor, in Benzie County. Both specimens are of about equal juvenile age (possibly two to three weeks) and apparently are a part of the young of one family. Both mice represent complete melanism, with no suggestion of the normal brownish hairs of this species. All hairs are black to their bases and the pelage presents a glossy appearance to the eye of the observer. Intensive efforts were made to secure mature individuals exhibiting the black characteristic, but without success. Four mature meadow mice trapped nearby are of normal brownish coloration. It may be of some significance that the continuously wet surface soil at this place is nearly black in color, and possibly has had an influence of some selective value toward a temporary preservation of the melanism present in this local group of meadow mice. All specimens taken in this locality are deposited, as round study-skins with skulls and as alcoholic specimens, in the collection of the Museum of Zoology, Division of Mammals, University of Michigan.—PHILLIP M. BLOSSOM, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

NOTE ON THE DEN SITE OF A RACCOON FAMILY

A number of artificial next boxes were placed in trees along lakes, sloughs and in the Neches River bottom in Trinity County, Texas, about 10 miles southwest of Lufkin on February 23 and 24, 1940, in the hopes of attracting nesting wood ducks. The boxes were constructed of nail kegs with an entrance, four by four and one-half inches, sawed in one side and a removable wooden top fastened on the open end. Sawdust was placed in the kegs as nest material, and two one-quarter inch holes were bored in the bottom to insure drainage. The kegs were attached to the trunks of trees with baling wire and nails.

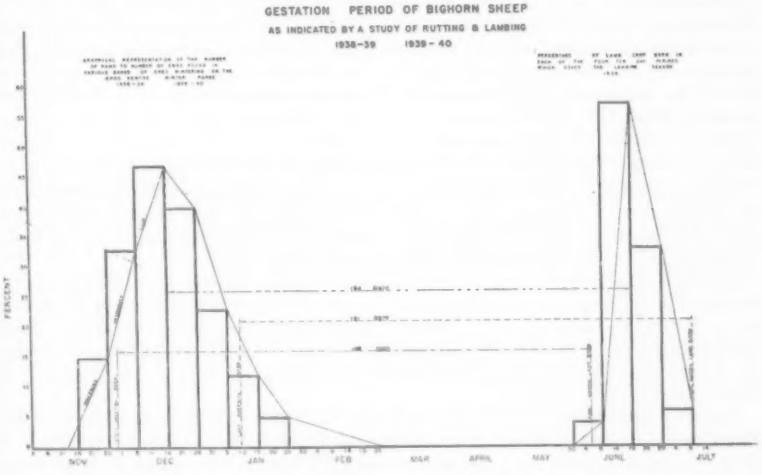
An inspection on April 15, 1941, of 25 kegs revealed one keg containing a female raccoon (*Procyon lotor fuscipes*) and three young. The young were estimated to be between 200 and 260 mm in length. Their eyes were not open, and the pelage was gray, thin and short, the dark mask on the face being the only raccoon-like aspect. The young were constantly making a squeaking noise. No nest materials were present other than the sawdust. Care was taken not to disturb the animals.

The keg occupied by the raccoon was situated about 16 feet up the trunk of a shortleaf pine. The tree was located in the water some 20 feet from the shore of an artificial lake. Since the tree's branches did not connect with the shore vegetation, the mother was obliged to swim to the tree from land. Algae and other aquatic vegetation covered the surface of the water in this portion of the lake, and two swimming trails were observed from land to the den tree. One trail led to the tree and another to an adjacent smaller pine from which the raccoon could cross to the keg. On returning to inspect the den on April 19, the female and young were gone.

Three other kegs examined (of a total of 24) had also apparently been used by raccoons. Where kegs had been inhabited by birds, wood rats, flying and tree squirrels, additional nest materials including oak leaves, twigs and pine needles were usually found. In the three kegs thought to be used by raccoons, no additional nest materials were found, and the sawdust was in a well-flattened condition as if some large-bodied animal had lain there. In this respect the condition of the sawdust was similar to that in the keg used by the raccoon family. Hair around the entrance was probably that of raccoon though no positive identification was made.—ROLLIN H. BAKER AND COLEMAN C. NEWMAN, *Texas Game, Fish and Oyster Commission, Lufkin, Texas.*

GESTATION PERIOD OF BIGHORN SHEEP, OVIS CANADENSIS

Since November of 1938 the Wyoming Game and Fish Commission has carried on a study of bighorn mountain sheep through the use of the Federal Aid in Wildlife Restoration Act



funds. The first concern of this study was to discover factors causing certain herds to decrease but incidentally many interesting facts concerning the life history of these animals were learned.

During the fall of 1938 and 1939 it was noticed that in northwestern Wyoming the actual rutting season for bighorn sheep extended from late November to early January, with the height of the season occurring between December 15–21. By the same sort of strict observations that made possible the fixing of dates on the rutting season, the lambing season was found to extend from the end of May until early in July with the height of the season coming between June 10–20. This knowledge of the exact breeding and lambing seasons proved interesting when correlated. While most references to the gestation period of

mountain sheep are carefully vague there is a general inclination to accept one hundred and fifty days. This study points to a period of one hundred and eighty days or slightly more.

Because the bighorn is a shy animal one infrequently observes an actual breeding even during the height of the rutting season. Due to this fact only seventeen breedings were observed during two rutting seasons. It was felt that this number was insufficient to give an accurate picture of the rutting season. Mature rams live with the ewes only during the season of the rut. Although they may occasionally be seen with ewes later in the winter, it is only a temporary meeting since only a few of the older rams continue to winter close by the ewes. It was therefore decided that a graph showing the gradual increase of the numbers of rams within the various bands of ewes and their subsequent gradual decrease would give a truer picture of the rutting season than would a graph of the actual breedings seen. Yet when the two graphs were plotted they corresponded very closely. Thus the figures shown on that part of the chart which refers to the rutting season are supported by figures of actual breedings seen.

The thin black lines running through the two sets of vertical columns touch, as closely as it was possible to see them, on the exact dates, which mark the beginning, zenith, and termination of the rutting and lambing seasons.

The vertical volumns shows percentages in ten day intervals, first of rams to the number of ewes in ewe herds, second to lambs born during each ten day period as against the total number of lambs born.

The interval of days between the height of the rutting season and the height of the lambing season; the first breeding seen and the first known lamb born; and the last breeding seen and the last known lamb born were not expected to come out exactly the same. That there is only a difference of seven days in the three lines supports the accuracy of any one of the observations.—Nedward M. Frost, *Wyoming Game and Fish Department, Cheyenne, Wyo.*

SYNAPTOMYS BOREALIS FROM FORT SEVERN, HUDSON BAY, ONTARIO

A second Ontario record of *Synaptomys borealis* (R.O.M.Z. no. 14, 646) was collected by the writer at Fort Severn, on July 11, 1940, while engaged in field work of the Royal Ontario Museum of Zoology. The specimen was taken in a water trap set on the alder- and willow-bordered bank of a stream draining a black spruce bog.

Lack of material prevents any conclusive racial determinations, but this specimen, an immature male, resembles the Moosonee specimen (S. C. Downing, Can. Field-Nat. vol. 54, no. 7) in color and measured as follows: Total length, 107; tail, 16; hind foot, 19 mm. The skull afforded the following measurements: Condylobasal length, 22.3; rostral length, 5.7; rostral breadth, 4.3; interorbital breadth, 3.6; zygomatic breadth, 13.9; incisive foramina, 4.6 mm.

The Fort Severn record fills in a wide gap in the range of *Synaptomys borealis*. Lake Winnipeg (A. B. Howell, North Amer. Fauna, no. 50, 1927) approximately 500 miles to the southwest and Moosonee (*loc. cit.*) approximately 500 miles to the southeast are the nearest localities from which the species has been recorded.—Leslie A. Prince, *Royal Ontario Museum of Zoology, Toronto, Ontario.*

THOMOMYS IN MINNESOTA

Specimens taken in northwestern Minnesota reveal the presence of the genus *Thomomys*, which has previously been overlooked in the state by Surber (1932) and Hatfield (1939). Johnson (1930), however, mentions that the Dakota pocket gopher *Thomomys talpoides rufescens* reaches Minnesota in the extreme northwestern corner but gives no evidence to support this statement. For this reason, perhaps, more recent publications dealing with the mammals of Minnesota have failed to include the genus. Bailey (1926) speaking of the

Dakota pocket gopher states, "At Pembina, in 1887, the writer found them common everywhere, except in the thickest growths of trees along the river and took specimens on both sides of the river as well as on both sides of the border line." (Pembina is located in the extreme northeastern tip of North Dakota and the river is Red River, which separates Minnesota from North Dakota). He too, other than this one statement, fails to include Minnesota in the range of the genus *Thomomys*.

We first obtained specimens in October, 1940, when Mr. Paul Blide, at the request of Dr. Gustav Swanson, collected 20 pocket gophers from Kittson County and sent them to University Farm, St. Paul. Ten of these were *Thomomys*; the others, *Geomys bursarius*. Four additional specimens of the former have been collected by the writer. The *Thomomys* from Minnesota have been compared with the Dakota pocket gopher *Thomomys talpoides rufescens* Wied and have been identified as the same.

In Kittson County, *Thomomys* seems to be restricted to the heavy clayey soil lying adjacent to Red River. This belt of heavy soil extends along the river from the southern boundary of Traverse County to the Canadian border and from east to west ranges from 5 to about 15 miles except at two points where narrow projections of a more loamy type extend to the river banks (Nikiforoff et al, 1939). East of this is a belt of mellow and loamy soils, which marks the eastern limit of *Thomomys* for here they are replaced by the larger *Geomys bursarius*. This line of demarkation between the two seems to be rather sharp for in the belt of heavy soils only *Thomomys* was taken and in the lighter soils only *Geomys* was found.

The difference in the nature of the soil, therefore, determines, at least in part, the distribution of these two pocket gophers. The larger *Geomys bursarius* must necessarily make larger burrows which seemingly prevents it from entering the heavy soil. The smaller *Thomomys*, on the other hand, is able to burrow in the tighter soil but is restricted thereto probably because the larger *Geomys* prevents it from spreading into the more mellow soils (for a brief discussion of the animosity between these two see Bailey, 1926, p. 126).

Even in this belt of heavy soil, however, *Thomomys* is by no means abundant, probably because the area is intensively farmed. Also, some of the farmers of this section continually wage war on this rodent, one reporting that he had taken 18 from his farm in the past year and that as far as he knew no more remained.

Although specimens of *Thomomys* have been taken only in Kittson County, the writer is of the opinion that their range extends south for some distance along the river. A series of mounds was observed one mile south of Alvarado, Marshall County, which, due to the small size of the underlying burrow, were thought to be those of *Thomomys*. Unfortunately, an attempt to trap this animal was unsuccessful.

The writer wishes to thank Mr. Paul Blide, Division of Game and Fish, Minnesota Department of Conservation, for collecting specimens and cooperation in the field work. Also, thanks are extended to Dr. H. H. T. Jackson, U. S. Fish and Wildlife Service, and Dr. W. H. Burt, Museum of Zoology, University of Michigan for the loan of specimens.

LITERATURE CITED

Bailey, Vernon, 1926. A biological survey of North Dakota. N. Amer. Fauna, no. 49, pp. 125–133.

Hatfield, D. M. 1939. Check-list of the mammals of Minnesota with keys for identification. Edward Bros., Ann Arbor, Michigan.

Johnson, Maynard S. 1930. Common injurious mammals of Minnesota. Bull. Univ. Of Minn. Agri. Exp. Sta., no. 259, p. 28.

Nikiforoff, C. C., *et al*. 1939. Soil survey (reconnaissance) of the Red River Valley area, Minnesota. U. S. Dept. Agric. Bur. Chem. and Soil, in cooperation with Univ. Minn. Agric. Exp. Sta., pp. 23–26.

Surber, T. 1932. The mammals of Minnesota. Publ. Minn. Dept. Conserv.

Don Quimby, *University Farm, University of Minnesota, St. Paul, Minn.*

THE LEAST BROWN BAT, MYOTIS SUBULATUS LEIBII, IN NEW YORK

At the time of publication of the "American Bats of the Genera *Myotis* and *Pizonyx*" by Miller and Allen in 1928 (Bull. U. S. Nat. Mus., No. 144) the least brown bat, *Myotis subulatus leibii*, was known from but six localities. Since then Mohr in Pennsylvania and Osgood and Griffin in New England have found new localities for this species. The only record from New York, however, has been that cited by Miller and Allen (*ibid*, p. 172) based on two alcoholic specimens from Sing Sing in the U. S. National Museum. Allen (Jour. Mamm., 1921, p. 53) has listed the bats known from the vicinity of Ithaca, New York, without mentioning this species. (His *M. subulatus* is now *M. keenii septentrionalis*).

On January 18, 1941, in company with Dr. W. M. Ingram and Mr. R. Priddy, I visited the small natural caves formed in the Tully limestone along the east shore of Cayuga Lake, four miles north of Ithaca, New York. In previous visits during the fall, winter, and spring of the past two years the caves had been either devoid of bats or sheltered a few *Pipistrellus subflavus* and *Myotis lucifugus*. On this occasion the larger fissure to the south, through which water drips and runs along the floor in the spring and winter, contained four *M. lucifugus* and five *P. subflavus*, while in the short northern crevice, which is comparatively dry, was a single bat, *M. subulatus leibii*. The specimen hung from the limestone in dim light only fifteen feet from the entrance. This is the first record from central New York, and the second locality for the species in the state. The specimen is a male with the characteristic black face and ears, and the short forearm, which measures 31 mm in length.

Recently, Mr. Donald Griffin has informed me of a second new station for *M. s. leibii*, this one again from the eastern part of the state. On March 2, 1941, he collected four specimens at Haile's Cave, Thatcher Park, Altamont, Albany County, New York. With this exception, the species has not been observed in the various caves in the vicinity of Albany.—Harold Trapido, *Zoological Laboratory, Cornell University, Ithaca, New York.*

SOREX LONGIROSTRIS LONGIROSTRIS IN MISSISSIPPI

In making a survey of the mammals of Mississippi through the aid of the W. P. A. Plant and Animal Survey, sponsored and directed by the State Game and Fish Commission, twenty long-tailed shrews have been collected in Jones and Wayne Counties in the eastern part of the state and one in Wilkinson County in the southwestern part of the state.

Because of their size and color, these shrews have been referred to *Sorex longirostris longirostris*. Comparison has been made with a specimen of *Sorex l. longirostris* from Young Harris, Georgia, loaned from the Biological Surveys' collection by permission of Hartley H. T. Jackson. This is the first record of the occurrence of the long-tailed shrew in Mississippi. The specimen found in the stomach of a barred owl killed by L. S. Golson in central Alabama is the westernmost specimen of this shrew reported in the Gulf Coast States.

Several nests, or beds, have been located during this survey, but no young or embryos have been found. The specimens were caught in mouse traps set in small, shallow runs under dead leaves and well-drained sandy loam near streams or draws in which there is permanent water.—Fannye A. Cook, *Game and Fish Commission, Jackson, Mississippi.*

WEASEL RECORD FROM MISSISSIPPI

On August 21, 1941, a weasel was received at the Mammal Laboratory of the United States Fish and Wildlife Service from near the Noxubee Refuge, Winston County, Mississippi. The animal was collected by Thomas J. Atkeson, and is the first weasel to be added to the Biological Surveys mammal collection from that state. The weasel is apparently a rarity in Mississippi, there being no representatives of it in the United States National Museum collection. The above specimen is referable to *Mustela frenata olivacea*.—Viola S. Schantz, *Fish and Wildlife Service, United Stated Department of the Interior, Washington, D. C.*

SOREX MYOPS, A SYNONYM OF SOREX TENELLUS

Jackson (N. Amer. Fauna, no. 51, pp. 173–174, July, 1928) differentiates *S. tenellus* Merriam, known to him by one specimen, from *S. myops* Merriam, of which he had but two, on the basis of narrower interorbital and rostral regions with weaker dentition. His measurements of interorbital breadth, maxillary breadth, and length of maxillary tooth row indicate these differences.

Later Burt (Trans. San Diego Soc. Nat. Hist., vol. VII, no. 36, pp. 391, 392, May 31, 1934) published measurements of 13 specimens from Charleston Peak, Nevada, said to have been identified by Jackson as *Sorex myops*. The cranial measurements of the type specimen of *tenellus* all fell within the extremes of the measurements of the series from Charleston Peak. Seemingly, therefore, *Sorex myops* falls as a synonym of *Sorex tenellus*, which has more than six years priority.

Cranial measurements of a specimen from ½ mile N. Wichman, Lyon County, Nevada, fall within the range of variation shown by the series of specimens from Charleston Peak (Burt, *loc. cit.*) except in the cranial breadth and maxillary breadth, which are respectively one-tenth and two-tenths of a millimeter larger. These measurements are nearer to those of *Sorex tenellus* than those of *Sorex ornatus ornatus* Merriam. The cranial breadth, although a little larger than in any known *tenellus*, is still considerably less than in *Sorex ornatus californicus* Merriam, known from the opposite, western side of the Sierra Nevada. Although the specimen from near Wichman bridges the gap between *tenellus* (including *myops*) and *californicus* in some degree, and although it is also geographically intermediate between these two races, the conservative choice is made of treating *tenellus* as specifically distinct from *californicus* at present. The one specimen at hand of *S. tenellus* (no. 86842 Univ. Calif. Museum of Vertebrate Zoology) from Charleston Peak, and the specimen from near Wichman, almost agree in coloration and are considerably lighter colored than any of the 34 *californicus* and 60 *ornatus* at hand. The June-taken *tenellus* from Charleston Peak may be paler by a slight degree than the December-taken specimen from Wichman.

The specimen of *Sorex tenellus* (no. 93900 Univ. Calif. Museum of Vertebrate Zoology) taken, by me, December 29, 1939, at an elevation of 5,000 ft., ½ mile N. Wichman, Lyon County, Nevada, extends the known range of *tenellus* about 85 miles to the northward. The animal was trapped beneath a lava boulder of a talus where *Artemesia tridentata*, *Ephedra*, and *Chrysothamnus* were the conspicuous plants.

The measurements of this specimen in millimeters are: Total length, 116; tail vertebrae, 42; hind foot, 11; condylobasal length, 15.1; palatal length, 6.1; cranial breadth, 7.3; least interorbital breadth, 3.2; maxillary breadth, 4.5; and maxillary tooth row, 5.5

The external measurements of this specimen are unreliable and probably too great. The animal was in a state of decay when taken from the trap and may have been stretched when measured. When Merriam named *myops* (Proc. Biol. Soc. Washington, vol. 15, p. 76, March 22, 1902), he arranged it as a subspecies of *tenellus*. Until 1928 when Jackson (*op. cit.*) published his revision of the North American long-tailed shrews only one questionably adult of *Sorex tenellus* and two adult specimens of *Sorex myops* were known. Today, although material is still scanty, Jackson says, "In view of the information you now have, I can see no objection to placing *Sorex myops* in synonymy under *Sorex tenellus*, and, of course, using *Sorex tenellus* for the White Mountains [type locality of *Sorex myops*] representative of the group". (Letter to E. Raymond Hall, dated May 3, 1940).

I wish to thank Dr. E. Raymond Hall of the Museum of Vertebrate Zoology, University of California, for placing at my disposal the material herein reported upon and for other assistance.—DONALD V. HEMPHILL, *Box 203, Calistoga, California.*

HERNIAS IN KANGAROO RATS

One is apt almost to regard hernias as afflictions to which weak human flesh is exclusively subject. Such, of course, is not actually the case. They are occasionally encountered in

different sorts of mammals and are not particularly rare in dogs. Certainly, however, they are far rarer in small wild mammals than in man and the occurrence is worth a brief record in print.

On October 6, 1940, Hubbard collected two female *Dipodomys ordii columbianus* at Hampton, Oregon, which proved to have hernias upon the left side and the specimens were sent to Howell for examination. The animals appeared to be in good condition otherwise. In one individual the site was an orifice about 3 x 4 mm directly through the abominal wall 1 to 2 mm ventral to (above) the "inguinal ligament" and directly ventral to the emergence of the femoral vessels. Through this protruded about 108 mm of small intestine, there being but 15 mm of the jejunum between the process and the caecum. The hernial process was coiled against the medial thigh, but a part of it had burrowed between mm. tensor fasciae latae and the vasti and so had reached the deep fascia of the lateral thigh.

The second individual had two hernias at about the transverse level of the knee and 1 cm apart, the process in each case involving about 1 cm of small intestine near its middle protruding through an orifice 2 or 3 mm in diameter.

These hernias were superior to the inguinal region and the situation practically precludes the possibility that they were due to inherent weakness of this part of the abdominal wall. The most likely theory, we think, is that they followed some local, punctate injury to the muscular wall of the abdomen, as by tooth or claw. It is interesting that the intra-abdominal pressure could be sufficient in a mammal of this size to force a hernial process through such a small orifice.—C. A. Hubbard, *Pacific University, Forest Grove, Oregon,* and A. B. Howell, *Johns Hopkins University, Baltimore, Maryland.*

CRYPTORCHIDISM IN A COYOTE

On March 31, 1941, the writer removed the skin and skull from an adult male coyote, *Canis latrans latrans*, trapped on March 29 by Claude Shrader in the Wichita Mountains Wildlife Refuge, Cache, Oklahoma. While skinning it about the scrotum, he noticed that only the left testis was present. Further investigation disclosed that only the left testis had descended into the scrotum. The right testis was found outside the internal inguinal ring inside the peritoneum. The looped vas deferens had descended to a position about midway in the inguinal canal. The length and diameter of the aberrant testis, exclusive of the epididymis, were 13 mm and 5 mm; the normal testis, 22 mm and 13 mm. To the writer's knowledge, this may be the first published record of a testis retained within the peritoneal cavity of an adult coyote although it is a condition frequently met with in various mammals.—Frank B. McMurry, *Fish and Wildlife Service, Cache, Oklahoma.*

A RECORD OF LUNGWORMS IN OVIS DALLI (NELSON)

On April 24, 1939, a mountain sheep, in weakened condition, was encountered at Polychrome Pass, Mt. McKinley National Park, Alaska. The animal, a male about 11 months old, was collected. Field examination revealed that it was extremely emaciated and suffered from infections resulting from bruises sustained in a severe fall. Portions of lung, liver, and skin were fixed in formalin for subsequent investigation. The liver and skin presented no findings of pathologic significance.

A number of blocks of lung tissue were taken at random from the preserved material for sectioning. Examination of the sections revealed the presence of numerous nematode adults, larvae and eggs in several of the samples. The adults were 40 to 80 micra in width; the larvae possessed caudal appendages but lacked dorsal spines; and the eggs, about 40 by 80 micra, appeared in all stages of segmentation. These characters as well as the host and habitat are regarded as evidence that these parasites belong to the genus *Protostrongylus* or its very close allies.

The only parasite record from *Ovis dalli* we have encountered is that of Philip (Jour. Parasitol., vol. 24, pp. 483–488, 1938), who found the larval stage of *Taenia hydatigena* in the white sheep. Dikmans (Proc. U. S. Nat. Mus., vol. 79, no. 18, 1931) described *Protostrongylus stilesi* from fragments removed from the parenchyma of the lungs of *Ovis canaden-*

sis. He stated that the macroscopic lesions resembled those in sheep infected with *Muellerius capillaris*. Little gross pathology was observable in our material on account of its state of fixation but the microscopic picture closely resembled that presented by infestation with the adults, eggs, and first stage larvae of *M. capillaris*. The formation of pseudotuberculous nodules which so frequently accompanies *Muellerius* infection in domestic sheep was not observed.—Frans C. Goble and Adolph Murie; *New York State Conservation Department, Albany, N. Y., and U. S. Fish and Wildlife Service, Washington, D. C.*

THE GUINEA-WORM IN A BONAPARTE WEASEL

In March 1939, a Bonaparte weasel (*Mustela cicognanii cicognanii*) was collected from a swamp in the township of Diana, Lewis County, New York by Mr. Ben Alexander. On both hind legs bunches were noted which, when the animal was pelted, were found to be caused by the presence of filarioid nematodes. One worm was found on each leg, coiled in the fascia between the skin and muscles in the tibial region. These parasites were found to be gravid females of the guinea-worm, *Dracunculus medinensis*, one measuring 230 mm and the other 335 mm in length.

D. medinensis (Linnaeus, 1758) is a serious parasite of man in a number of tropical countries and has only been reported in the United States since 1932 when Benbrook (Jour. Am. Vet. Med. Assn. vol. 34, pp. 821–824) found it in a fox in Iowa. Chitwood (1933, Jour. Am. Med. Assn. vol. 100, pp. 802–804) recorded it from raccoon in New York and Ontario and from mink in Nebraska. Benbrook recently (1940, Jour. Am. Vet. Med. Assn. vol. 46, pp. 260–263) reported this worm from a dog in South Dakota and published a photograph of a case in a mink from an Iowa fur farm in which two worms were found disposed, one on each hind leg, in a manner strikingly similar to that observed in the Bonaparte weasel.

Larvae of this parasite are liberated into water by rupture of the skin over the gravid female. The larvae are ingested by *Cyclops* in which they reach the infective stage. They enter the definitive host when water containing the infected *Cyclops* is ingested.—Frans C. Goble, *N. Y. State Conservation Dept., Wildlife Research Center, Delmar, New York.*

FURTHER RECORDS OF THE DALL PORPOISE IN CALIFORNIA

Joseph Grinnell, in his "Review of the Recent Mammal Fauna of California" (Univ. Calif. Publ. Zool., vol. 40, p. 216, 1933) recorded *Phocoenoides dalli* from a single specimen taken in June, 1925, near Santa Cruz Island. On May 22, 1941, at 10 a.m., we were cruising on a whaling vessel fifteen miles southwest of Crescent City, California, when four Dall porpoises appeared at the bow. They played about the ship for several minutes, enabling us to see clearly at a distance of about fifteen feet the distinctive white area on the posterior half of the underparts. Their behavior while swimming was characteristic of the species as we have observed it in Southeast Alaska and the Aleutian Islands. About 1 p.m. on the same day we again saw four Dall porpoises. These may have been the same individuals, although the ship had, in the meanwhile, covered a distance of twenty-five miles.

On a seven-day trip from San Pedro, California, to Seattle, Washington, on the motor schooner "Black Douglas," Dr. Wilbert M. Chapman and I saw Dall porpoises playing at the bow of the ship on four different occasions. On December 15, 1941, at 2:45 p.m., ten miles off Point Sur, California, (twenty miles south of Monterey) we watched a group of about 15 Dall porpoises crossing back and forth ahead of the vessel, breaking water with the dorsal fin and blowhole with a quick, explosive rush. We were within six feet of the animals at times. On the morning of December 17, 15 miles off Fort Ross, California, we saw five Dall porpoises. At noon on December 19, 30 miles off Yaquina Head, Oregon, we saw five Dall porpoises, at least one of which was immature. An hour later Dr. Chapman saw 12 others. Our last observation of Dall porpoises was at 9:40 a.m., on December 20, 19 miles west of Copalis, Washington. During the entire trip only one other species of porpoise was encountered.—Victor B. Scheffer, *Fish and Wildlife Service, Seattle, Washington.*

THE HARBOR SEAL OF THE WESTERN PACIFIC

In a recent paper Erna Mohr (1941, p. 58) described what she thought to be a new species of seal. This species *Phoca petersi*, was based on two immature specimens, male and female, from an unspecified locality along the coast of Corea. Two additional specimens, one from Hokkaido, and one from Ysembeck Bay, near Port Moller, Alaska Peninsula, were referred to the same species. The description given, although long, is not very clear. Comparison is made with several other species of seals, but there is no differential diagnosis. From the photographs, and outline drawings, which accompany the description, the following facts can be gathered which allow for comparison with the material at hand, and with the elaborate description and figures published by Ognev (1935, pp. 512–40).

(1) There can be no doubt that the animal belongs to the *vitulina* group. Comparison with other species, therefore, is unnecessary.

(2) According to the explanation of the figures given by the author, the following characters distinguish *petersi* from *vitulina*:

In *petersi*, (a) pars horizontalis of palatal broad, square; posterior process of maxillary not much broader than the diameter of the last molar; (b) lateral anterior process of nasal about as long as median; (c) incisive foramina completely within premaxillary; (d) vacuity in orbital portion of maxillary not partitioned.

In *vitulina*, (a) pars horizontalis of palatal, rounded anteriorly; posterior process of maxillary about twice as broad as last molar; (b) lateral anterior process of nasal much longer than median; (c) incisive foramina extending into maxillary; (d) vacuity in orbital portion of maxillary partitioned.

To ascertain the status of Mohr's specific name, I have examined the material of Pacific harbor seals in the U. S. National Museum. Elaborate accounts of the characters, and distribution, of these seals have been given by J. A. Allen (1902, pp. 459–99), Ognev (1935, pp. 523–40), and Kuroda (1940, pp. 23, 25, figs. 22, 24).

The character under (a) is fairly constant in skulls of *Phoca vitulina largha* Pallas. It is shown in Ognev's figure no. 252. The character under (b) is less constant, although more frequent in Pacific, than in Atlantic skulls. The character under (c) is fairly constant. The character under (d), viz. the degree of ossification of the vacuity in the orbital part of the palatal, greatly depends on age; obviously ossification is greater in adult, than it is in young skulls, such as the ones described by Mohr. I admit that ossification of the whole skull, and, therefore, local ossification, is greater in Atlantic than it is in Pacific skulls.

Phoca vitulina largha Pallas, according to Ognev and Kuroda, is found along the whole coast of Eastern Asia, as far south as Vladivostok, and the islands of Saghalien, and Hokkaido; a record from the Corean coast, therefore, would not be surprising.

According to Ognev, *P. v. largha* Pallas, includes as synonyms the following names given to harbor seals from the northwest Pacific: *chorisii* Lesson, *nummularis* Temminck, *ochotensis* Allen, *macrodens* Allen, *stejnegeri* Allen, and *pribilofensis* Allen. From his data and from the material at hand, it appears that this form ranges all through the Bering Sea, and beyond, at least as far as Point Barrow, Alaska. A skull before me from this last locality (U. S. Nat. Mus. No. 225795) is identical in every respect, even the shape of the orbital vacuities, with the type skull of *petersi* figured by Mohr. This name becomes a clear synonym of *largha*.

The material at hand shows, however, that the harbor seals from the Pacific coast of North America, south of the Alaska Peninsula, can be separated from *largha*. There is a northern type, *P. v. richardii* Gray, and a southern, *P. v. geronimensis* Allen, which is easily distinguishable by its dark color.

LITERATURE CITED

ALLEN, J. A. 1902. The hair-seals (*Phocidae*) of the North Pacific Ocean and Bering Sea. Bull. Am. Mus. Nat. Hist. vol. 16, pp. 459–99.

KURODA, N. 1940. A monograph of the Japanese mammals. Tokyo and Osaka.

MOHR, E. 1941. Ein neuer westpazifischer Seehund. Zool. Anz. vol. 133, pp. 49–60.

OGNEV, S. I. 1935. The mammals of USSR and adjacent countries. vol. 3, pp. 512–40. Moscow.

ERNST SCHWARZ, *Washington, D. C.*

PARABOS DODSONI BARBOUR AND SCHULTZ: A Correction

A *Bos*-like animal, *Parabos dodsoni*, was recently described by Barbour and Schultz (1941, "A New Fossil Bovid from Nebraska", Bull. Univ. Nebr. State Museum, Vol. II, No. 7, pp. 63–66, Figs. 24–27, December) as a new genus and species from the Pleistocene of Nebraska. Attention has been called to the writers by Dr. E. H. Colbert of the American Museum of Natural History that the name *Parabos* is preoccupied. *Parabos* was introduced as a generic name by C. Arambourg and J. Piveteau (1929, "Note preliminaire sur un Ruminant du Pliocene inferieur du Roussillon," C. R. Bull. Soc. Geol. de France, 4th Ser., XXIX, pp. 144–146). Unfortunately the reference was missed by the present writers as well as by the editors of the Zoological Record (1929–1939).

The writers propose the name *Platycerabos* to replace *Parabos* for the new American bovid. The corrected designation would thus be *Platycerabos dodsoni* (Barbour and Schultz).

The occurrence of a *Bos*-like form from the Pleistocene of North America is unique. It has long been thought that the migration of true bovines from Asia to North America during the Pleistocene was limited to *Bison*, but the discovery of *Platycerabos dodsoni* has altered this belief.—ERWIN HINCKLEY BARBOUR AND C. BERTRAND SCHULTZ, *University of Nebraska State Museum, Lincoln, Nebraska.*

THE WESTERN RED FOX IN SOUTHERN NEW MEXICO

On January 28, 1942 a Western Red Fox (*Vulpes macroura*) was accidentally caught by Cecil A. Kennedy on the San Andres National Wildlife Refuge, located in the San Andres Mountains of Dona Ana County, south-central New Mexico. Bailey (N. Amer. Fauna No. 53, 1931, pp. 296 and 297) records this fox from northern New Mexico and also from the Mogollon Mountains in the western part of the state. This last observation was "at about 8,000 feet at the junction of the Transition and the Canadian Zones." The observations from northern New Mexico include the higher elevations with one den being recorded from 12,400 feet.

The San Andres specimen, however, was caught on a ridge at about 5,500 feet elevation. The vegetation at this point is distinctly Sonoran and composed in part of rosinweed (*Viguiera sp.*) sotol (*Dasylirion wheeleri*), yucca (*Yucca sp.*), prickly pear (*Opuntia sp.*), side oats grama (*Bouteloua curtipendula*), and hairy grama (*B. hirsuta*).

The skull and skin were sent to Dr. H. H. T. Jackson and Major E. A. Goldman of the Washington office staff of the Fish and Wildlife Service, who kindly identified the specimen. It has been suggested that this animal may have escaped from captivity and that it may not be native to this area. The local ranchers, however, assert that they have known of red foxes for many years and expressed surprise that we had not before seen one. Townsend (Science, XXII, 1893, pp. 313–315) mentions that "red and silver foxes (Vulpes spp.)" occur in the Organ Mountains, a range south of and connecting with the San Andres Mountains. The rather isolated locality in which the animal was caught also lends credence to the theory that this species may be a resident of this desert mountain range.—ARTHUR F. HALLORAN, *San Andres National Wildlife Refuge, Las Cruces, New Mexico.*

TWENTY-FOURTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The twenty-fourth annual meeting of the American Society of Mammalogists was held at the American Museum of Natural History, New York, from March 31 to April 4, 1942, with 136 members and visitors, representing 21 states, Alaska, the District of Columbia, and Canada, present.

PROGRAM

TUESDAY, MARCH 31

9:00 *p.m.*

Meeting of the Board of Directors, Hotel Piccadilly

WEDNESDAY, APRIL 1

9:45 *a.m.*

1. Address of Welcome. Mr. Wayne M. Faunce, Acting Director, The American Museum.
2. Response by a Vice-President of the Society, A. Brazier Howell.
3. Audubon Society reports on the Florida deer situation. John H. Baker, National Audubon Society.
4. Wildlife conservation as affected by American Indian and Caucasian concepts. Clifford C. Presnall, U. S. Fish and Wildlife Service. (Read by O. J. Murie.)

SYMPOSIUM ON BAT BANDING

5. Migrations of New England bats. Donald R. Griffin, Harvard University. Slides.
6. Ten years' bat marking in Pennsylvania. Charles E. Mohr, Philadelphia Academy of Sciences. Slides.
7. Results of wing banding of some cave-inhabiting bats. Harold Trapido, Cornell University. Slides.
8. Demonstration of equipment developed for use in marking bats. D. R. Griffin, C. E. Mohr, and H. Trapido.

2:00 *p.m.*

Annual Business Meeting of the Society

9. The giant red-headed hamster (*Cricetulus triton nestor* Thomas) of Manchuria. Anatole S. Loukashkin, San Francisco. (Read by title only.)
10. The hyoid region in the Epomophorine bats. James M. Sprague, Harvard University. Slides.
11. The muzzle gland of the Pacific pallid bat, *Antrozous pallidus pacificus*. Carl H. Engler, Cornell University.
12. A poisonous substance in shrews. Oliver P. Pearson, Swarthmore College. Slides and moving pictures.

THURSDAY, APRIL 2

9:00 *a.m.*

13. Field observations on prairie dogs in Costilla County, Colorado. William Longhurst, Cornell University. Slides.
14. Habits of the rice rat (*Oryzomys palustris*). W. J. Hamilton, Jr., Cornell University. Slides.
15. Food of the otter in Michigan. Karl F. Lagler and Burton T. Ostenson, University of Michigan and Michigan State College. Slides.
16. Notes on coyote food habits in Montana and British Columbia. O. J. Murie, U. S. Fish and Wildlife Service.

17. Observations on the summer food of beaver. David B. Cook, New York Conservation Department. Slides.
18. Distribution of mammals in Sonora. Seth B. Benson, Museum of Vertebrate Zoology.
19. An unusual instance of parturition in *Erethizon dorsatum* and the development of the young. Albert R. Shadle and William R. Ploss, University of Buffalo. Slides.
20. Ecology and behavior of the Canadian porcupine in New England. Donald A. Spencer, U. S. Fish and Wildlife Service. Slides.
21. A margay (*Leopardus pirrensis*) in the home. E. R. Dunn, Haverford College. Slides.

1:45 *p.m.*

22. The translation of Herluf Winge's "The interrelationships of mammalian genera," volume I. Elisabeth Deichmann, Harvard University. Slides.
23. Notes on the gray fox in captivity. Walter P. Taylor, Texas Cooperative Wildlife Research Unit. (Read by title only.)
24. Some determinations of apparent home range of *Microtus* in Michigan. D. W. Hayne, Michigan State College. Slides.
25. Use of the nest box technique for studying the movements of individual deer mice. Walter E. Howard, University of Michigan. Slides.
26. The marking of squirrels for field identification. W. D. Fitzwater, Jr., Connecticut Board of Fisheries and Game.
27. A comparison of North American small-mammal censuses. Carl O. Mohr, Illinois Natural History Survey. Slides.
28. Incidence of dipteran parasitosis in a mouse population. Frederick H. Test and Avery R. Test, University of Michigan.
29. The midwestern subspecies of *Tamias striatus*. Donald M. Hatfield, Chicago Academy of Sciences. Slides.
30. Utility of the photronreflectometer in serological investigations on *Peromyscus*. Paul A. Moody, University of Vermont. Slides.
31. Identification of species in the rodent genus *Peromyscus* by specific differences in rate of osmotic hemolysis. Harry P. Levine, University of Vermont. Slides.
32. Experimental removal of muscle and bone in the laboratory rat. Loring W. Pratt, Johns Hopkins Medical School. Slides.
33. The heart of domestic sheep not adapted to prolonged or strenuous running. Thomas Horace Evans, New York Medical College. Slides.
34. Aspen reforestation after depletion by beaver at Allegheny State Park, New York. Albert R. Shadle and Edward Gese, University of Buffalo. Slides.

8:00 *p.m.*

Smoker, exhibition of paintings and photographs of vertebrate animals, and kodachrome motion pictures "Wildlife at Denali" by Adolph Murie, U. S. Fish and Wildlife Service (Presented by O. J. Murie).

Friday, April 3

9:00 *a.m.*

Symposium on the Criteria for Vertebrate Subspecies, Species, and Genera

(Joint meeting with the American Society of Ichthyologists and Herpetologists and the Society of Vertebrate Paleontologists.)

35. Criteria for subspecies, species and genera in fishes. Carl L. Hubbs, University of Michigan.
36. Criteria for subspecies, species and genera in amphibians and reptiles. E. R. Dunn, Haverford College.
37. Criteria for subspecies, species and genera in birds. Ernst Mayr, The American Museum of Natural History.

38. Criteria for subspecies, species and genera in mammals. E. Raymond Hall, University of California.
39. Criteria for subspecies, species and genera in paleontology. G. G. Simpson, The American Museum of Natural History.
40. Criteria for subspecies, species and genera from the viewpoint of genetics. W. F. Blair, University of Michigan.

1:45 *p.m.*

41. Some remarks on the origins and the distribution of the ungulates. Edwin H. Colbert, American Museum of Natural History. Slides.
42. Evolution of the horse brain. Tilly Edinger, Harvard University.
43. Pylogenetic and adaptational implications of the superficial musculature of squirrels. Monroe D. Bryant and E. Raymond Hall, University of California. Slides.
44. Spiral burrows of rodents—fossil and Recent. C. Bertrand Schultz, University of Nebraska. Slides.
45. Some considerations of Pleistocene and Recent zoogeography of mammals in the Bering Strait region. Raymond M. Gilmore, Cornell University.
46. Behavior and social relations of the Rhesus monkey (*Macaca mulatta*). C. R. Carpenter, Pennsylvania State College. (Read by title only.)

3:45 *p.m.*

Final Business Meeting of the Society

7:00 *p.m.*

The annual dinner of the Society was held at the American Museum of Natural History. Motion pictures of American Big Game, in color, by Cleveland and Ruth Grant.

SATURDAY, APRIL 4

10:30 *a.m.*

Visit and luncheon at the Bronx Zoo. Members were conducted on a tour of the Zoo and served lunch through the courtesy of the officials of the New York Zoological Park.

At the meeting of the Board of Directors on March 31, the board recommended: adoption of a calendar year as the operating (fiscal) year of the Society, that year to be defined under Rule 4 of the By-laws; that W. Reid Blair be re-elected to succeed himself for a three-year term as trustee; that a special committee be selected by the Society's Committee on Nomenclature to act pro tem in the present world crisis for the Committee on Nomenclature of the International Zoological Commission; that the invitation extended to the Society by the Carnegie Museum to hold the 1943 annual meeting in Pittsburgh be accepted. The Corresponding Secretary was instructed to reduce at his discretion the stored stock of the Journal of Mammalogy. W. B. Davis was re-appointed chairman of the Editorial Committee.

At the annual business meeting on April 1, the recommendations (mentioned above) of the Board of Directors were accepted.

The following officers were elected: A. Brazier Howell, President; E. Raymond Hall and Edward A. Goldman, Vice-Presidents; Seth B. Benson, Recording Secretary; Emmet T. Hooper, Corresponding Secretary; Viola S. Schantz, Treasurer. Five directors were elected for the period 1942-1944 as follows: William H. Burt, J. Kenneth Doutt, Claude W. Hibbard, Olas J. Murie, and W. E. Saunders.

The two amendments to Article VIII of the By-Laws which proposed to allow (1) a premium of $.50 for prompt payment of dues and (2) payment of a life membership in five installments over a period of 18 months were tabled for consideration later.

It was with deep regret that the Society learned of the deaths of twelve members, six of whom were charter (*) members: *Glover M. Allen, Benjamin P. Bole, Malcolm J. Brumwell, Herbert Fox, Frank B. Foster, *Walter W. Granger, Wharton Huber, *C. Hart Merriam, *J. H. Riley, *George Shiras, 3rd, *Myron H. Swenk, and Casey A. Wood.

The following is a summary of the report of the Corresponding Secretary:

	1940	1941	1942
New members elected at annual meeting	77	108	59
New subscriptions	20	24	15
Total gross additions to mailing list	97	132	74
Resignations	21	19	23
Deaths reported	11	16	12
Subscribers delinquent	29	30	45
Annual members dropped for delinquency	31	43	54
Annual members delinquent two years	52	66	40
Annual members delinquent one year	87	76	126
Lost addresses (Life members)			4
Total gross loss to mailing list	231	250	304
Number of honorary members	3	3	4
Number of life members	51	51	49
Number of annual members in good standing	718	753	689
Total number of delinquent members	139	142	166
Total number of members	908	949	908
Members not receiving Journal	3	5	5
Number of paid subscribers	189	210	188
Total mailing list at this date	958	1012	925

Reports of the following standing committees were read and placed on file: Editorial, Conservation of Land Mammals, Anatomy and Phylogeny, and Membership.

At the final business meeting on April 3, the two amendments which had been tabled at the preceding meeting were recalled for discussion and vote. Both amendments were rejected.

Dr. Marcus Ward Lyon, Jr., was nominated and unanimously elected to Honorary Membership in the Society.

The Index Committee reported that the first draft of the twenty year index to the Journal of Mammalogy has been completed. Much checking of items remains, however, and the manuscript probably will not be ready for printing for several months.

The following resolutions were read and adopted:

Resolved, that the American Society of Mammalogists tender its sincere thanks and appreciation to the President, Trustees, Acting Director, and Staff of the American Museum of Natural History, to the Officers and Staff of the New York Academy of Sciences, to the Officers and Staff of the New York Zoological Society, and to members of the Local Committee on Arrangements, for their generous hospitality and effective efforts contributing to the success of its 24th Annual Meeting and to the enjoyment of all members and their families and friends in attendance.

In times of stress, such as the present, there is danger that public resources of permanent value may be exploited unduly to furnish food and other materials.

Be it resolved, therefore, that the American Society of Mammalogists at its 24th annual meeting, April 3, 1942, goes on record as opposing the use of any such materials from National Parks, National Monuments, or National and State Wildlife Refuges, unless it be demonstrated that such materials cannot be obtained elsewhere.

Whereas investigations are now in progress to determine whether it will be necessary to exterminate the deer of the Seminole Indian Reservation in order to eradicate tick fever in cattle **Therefore, be it resolved** that the American Society of Mammalogists, at its 24th stated annual meeting, April 3, 1942, goes on record as opposing destructuion of the deer until the investigations are completed and the results are made public for consideration by the authorities concerned and with due regard to the rights of the Indians.

RECENT LITERATURE

(Conducted by Gerrit S. Miller, Jr., Remington Kellogg, and Emma M. Charters)

ABBOTT, MARY OGDEN. The pursuit of Old Juan. Nat. Hist., New York, vol. 48, no. 1, pp. 25–27, illus. June, 1941. (Jaguar, *Felis onca*.)

AFANASSIEFF, S. W. Zur Frage über die Herkunft der Pferdetypen. Zapiski Detskoselskoi Zootehknicheskoi Laboratorii (Annals Zootech. Labor. Detskoje Selo), Leningrad, no. 15, pp. 73–74, figs. 30. 1936. (Frozen horses from burial at Pazarik, Oirotischer Distr., Sajan-Altai district, USSR., 1928. (Probably 300 B.C.–100 B.C.)

AGAR, R. S. The man-eating leopard of Punanai. Loris, Ceylon, vol. 1, no. 5, pp. 268–280, illus. December, 1938.

ALDOUS, SHALER E. Deer management suggestions for northern white cedar types. Jour. Wildlife Management, Menasha, vol. 5, no. 1, pp. 90–94. January, 1941.

ALLEN, FRANK, and MANUEL SCHWARTZ. The effect of stimulation of the senses of vision, hearing, taste, and smell upon the sensibility of the organs of vision. Jour. General Physiology, Baltimore, vol. 24, no. 1, pp. 105–121, figs. 7. September 20, 1940.

ALMIRALL, LEON V. The missing lynx. Western Sportsman, Denver, vol. 7, no. 2, pp. 25, 32, illus. July, 1941.

ANDREWS, ETHAN ALLEN. Zoological gardens. I. Scientific Monthly, Lancaster, vol. 53, no. 1, pp. 5–21, illus. July, 1941.

ANONYMOUS. Animal mummies. Field Mus. News, Chicago, vol. 12, no. 5, p. 5. May, 1941.

——— Large beaver trapped by Fred Wiedrick, Fern Ridge, Monroe County. It weighed 68 pounds. Pennsylvania Game News, Harrisburg, p. 26, photo. May, 1941.

——— Mink raising. U. S. Dept. Interior, Fish and Wildlife Serv., Wildlife Leaflet 191, 10 pp. May, 1941.

——— Little things. Zoonooz, San Diego, vol. 13, no. 6, pp. 3–4, illus. June, 1941. (Ocelot, foxes, pandas.)

——— New acquisitions. Zoonooz, San Diego, vol. 13, no. 6, pp. 5–7, illus. June, 1941. (Pigmy hippopotamus, white-bearded gnu, eland.)

——— Camels do not store water in either hump or stomach. Science News Letter, Washington, D. C., p. 382. June 14, 1941.

ANTHONY, H. E. Mammals collected by the Vernay-Cutting Burma Expedition. Papers on Mammalogy. Zool. Ser., Field Mus. Nat. Hist., vol. 27, pp. 37–123, fig. 5, pls. 2–5. December 8, 1941. (New: *Neotetracus sinensis cuttingi*, *Chodsigoa smithii furva*, *Vernaya* for *Chiropodomys fulvus* G. M. Allen, *Ochotona osgoodi*.)

ANTHONY, R., and M. FRIANT. Théorie de la dentition jugale mammalienne. III. Critique du trituberculisme. Exposés d'anatomie comparée publiés sous la direction de R. Anthony, Actualités Scientifiques et Industrielles, Paris, no. 456, 51 pp., 16 figs. 1937.

AOKI, BUNICHIRÔ, and RYÔ TANAKA. The rats and mice of Formosa illustrated. Mem. Faculty Sci. and Agric., Taihoku Imperial Univ., Taiwan, vol. 23, no. 4, (Zool. no. 13), pp. 121–191, illus. May, 1941.

ASDELL, S. A., and G. W. SALISBURY. The rate at which spermatogenesis occurs in the rabbit. Anat. Record, Philadelphia, vol. 80, no. 2, pp. 145–151, pl. 1. June 25, 1941.

ASHBROOK, FRANK G. The need for research in fur animal production. Jour. Wildlife Management, Menasha, vol. 5, no. 2, pp. 139–140. April, 1941.

AVERY, BERT. Modern fox mutations. Platinums and white face silvers. Amer. Fur Breeder, Duluth, vol. 13, no. 12, pp. 16, 20, fig. 1. June, 1941.

BAILEY, JOSHUA L. A contribution to the theory of evolution by natural selection. Amer. Nat., Lancaster, vol. 75, no. 758, pp. 213–230, tables 4. May–June, 1941.

BARBOUR, ERWIN HINCKLEY, and C. BERTRAND SCHULTZ. A new species of *Sphenophalos* from the upper Ogallala of Nebraska. Bull. Univ. Nebraska State Mus., Lincoln, vol. 2, no. 6, pp. 59–62, fig. 23. June, 1941.

BARCROFT, JOSEPH. The development of function in the mammalian organism. Roy. Inst. Great Britain, Special Afternoon Lecture, 13 pp. May 20, 1941.

——— Evolution of function in the mammalian organism. Nature, London, vol. 147, no. 3738, pp. 762–765. June 21, 1941.

BARNES, WILL C. The big little mountains. The Wichita—Oklahoma's famous forest and preserve. Nature Mag., Washington, D. C., vol. 14, no. 4, pp. 215–218, illus. October, 1929.

BARTHOLOMEW, JAMES. The grey squirrel. Glasgow Nat., vol. 11, pp. 34–45. April, 1933. (*Sciurus carolinensis leucotis* introduced in Cheshire in 1876; introduced in South Africa by Cecil Rhodes.)

BARTON, D. R. One-man explorer. Without benefit of base camps and elaborate supply lines, Harry Raven has ventured alone into some of the world's least known jungles. These exploits rank him among the great fieldmen of our time, while his laboratory studies in comparative anatomy have brought him international scientific fame. Nat. Hist., New York, vol. 48, no. 1, pp. 52–57, 61, photo. June, 1941.

BAUMAN, JOHN. The migration of moose. Yellowstone Nat. Notes, Yellowstone Park, vol. 18, nos. 5–6, p. 33. May–June, 1941.

BELLROSE, FRANK C., and LOUIS G. BROWN. The effect of fluctuating water levels on the muskrat population of the Illinois River Valley. Jour. Wildlife Management, Menasha, vol. 5, no. 2, pp. 206–212. April, 1941.

BENCHLEY, BELLE J. Rare monkeys. Zoonooz, San Diego, vol. 12, no. 11, pp. 1–5, illus. November, 1940.

BENNETT, G. A., and A. J. RAMSAY. Experimental studies on the movements of the mammalian tongue. 1. Movements of the split tongue (dog). Anat. Record, Philadelphia, vol. 79, no. 1, pp. 39–51, 2 pls. January 25, 1941.

BERNSTRÖM, JOHN. Meddelanden om svenska däggdjur. Fauna och Flora, Uppsala, 1941, no. 4, pp. 173–176. 1941.

BISSONNETTE, THOMAS HUME. A two-faced kitten. Jour. Heredity, Washington, D. C., vol. 24, no. 3, pp. 103–104, figs. 5–6. March, 1933.

BJÖRKEGREN, BERTIL. On a new weasel from northern Tonkin. Arkiv f. Zool., Uppsala, vol. 33B, no. 15, pp. 1–4, figs. 2. July 12, 1941. (New: *Mustela tonkinensis*.)

BLAIR, W. FRANK. A simple and effective live trap for small mammals. Jour. Wildlife Management, Menasha, vol. 5, no. 2, pp. 191–193, fig. 1. April, 1941.

——— Some data on the home ranges and general life history of the short-tailed shrew, red-backed vole, and woodland jumping mouse in northern Michigan. Amer. Midland Nat., Notre Dame, vol. 25, no. 3, pp. 681–685. May, 1941.

BLANDAU, RICHARD J., and EDWIN S. JORDAN. The effect of delayed fertilization on the development of the rat ovum. Amer. Jour. Anat., Philadelphia, vol. 68, no. 2, pp. 275–291, 2 pls. March 15, 1941.

BOLING, JOHN, RICHARD J. BLANDAU, ARNOLD L. SODERWALL, and WILLIAM C. YOUNG. Growth of the graafian follicle and the time of ovulation in the albino rat. Anat. Record, Philadelphia, vol. 79, no. 3, pp. 313–331, 2 pls. March 25, 1941.

BOLING, JOHN L., RICHARD J. BLANDAU, BREWSTER RUNDLETT, and WILLIAM C. YOUNG. Factors underlying the failure of cyclic mating behavior in the albino rat. Anat. Record, Philadelphia, vol. 80, no. 2, pp. 155–170, pl. 1. June 25, 1941.

BOWER, WARD T. Alaska fishery and fur-seal industries in 1939. U. S. Dept. Interior, Bur. Fisheries, Adm. Rept., No. 40, pp. 97–184. 1941.

BRAESTRUP, F. W. A study on the Arctic fox in Greenland. Immigrations, fluctuations in numbers based mainly on trading statistics. Meddelelser om Grønland, København, vol. 131, pp. 101, figs. 6, pl. 1. 1941.

BRITTON, W. S. Form and function in the sloth (concluded). Quart. Rev. Biol., Baltimore, vol. 16, no. 2, pp. 190–207, figs. 14–19. June 25, 1941.

BRODRICK, HAROLD J. Millions of bats. National Park Service, Region 3 Quarterly, vol. 3, no. 3, pp. 3–6, mimeog. July, 1941.

BROOM, R. On two Pleistocene golden moles. Ann. Transvaal Mus., Cambridge, vol. 20, pt. 3, pp. 215–216, 1 fig. September 12, 1941. (New: *Proamblysomus*, *P. antiquus*, *Chlorotalpa spelea*.)

BURROUGHS, R. D., and LAURENCE DAYTON. Hunting records for the prairie farm, Saginaw County, Michigan, 1937–1939. Jour. Wildlife Management, Menasha, vol. 5, no. 2, pp. 159–167. April, 1941.

BURTSCHAK-ABRAMOWITSCH, M. Über den Fund eines Mammuts im Dorfe Tyschtschinzi im Kyjiwer Gebiet. Vseukraïnska Akad. Nauk, Trudy Prirodnicho-tekhnichnii Viddil, Kief, Lief. 8, pp. 133–139. 1935. (In Russian with German summary.)

BUTLER, P. M. A theory of the evolution of mammalian molar teeth. Amer. Jour. Sci., New Haven, vol. 239, no. 6, pp. 421–450, figs. 10. June, 1941.

CABRERA, ANGEL. Los nombres cientificos de algunos monos americanos. Ciencia, Mexico, D. F., Año 1, no. 9, pp. 402–405. November 1, 1940. (New: *Alouatta guariba clamitans* for *Alouatta fusca guariba* von Ihering, 1914, preoccupied; *Alouatta seniculus arctoides* for *Alouatta ursina* (Humboldt), 1812, preoccupied.)

——— Los caballos enanos del Cañon del Colorado. Un ejemplo del efecto del aislamiento geografico. Revista Argentina de Zoogeografia, Buenos Aires, vol. 1, no. 1, pp. 3–9, pl. 1. 1941. (A herd of small horses on an isolated plateau called "The Throne" in Grand Canyon. One 6-year old horse was 85 cm. high.)

CAHALANE, VICTOR H. A trap-removal census study of small mammals. Jour. Wildlife Management, Menasha, vol. 5, no. 1, pp. 42–67, 2 pls. January, 1941.

CAMERON, JOHN. Contour of orbital aperture in representatives of modern and fossil Hominidae. Amer. Jour. Phys. Anthropol., Philadelphia, vol. 3, no. 4, pp. 476–488, figs. 6. October-December, 1920.

CAPONNETTO, ANDREA. Sulla morfologia della pelvi e dei calici renali. Ricerche anatomo-comparative. Archiv. Italiano Anat. e Embriol., Firenze, vol. 34, fasc. 3, pp. 293–339, 38 figs. May 10, 1935.

CASTLE, W. E., HELEN DEAN KING, and AMY L. DANIELS. Linkage studies of the rat (*Rattus norvegicus*) IV. Proc. Nat. Acad. Sci., Washington, D. C., vol. 27, no. 6, pp. 250–254. June, 1941.

CHAPMAN, FLOYD B. The 1940 squirrel harvest on ten public hunting preserves in Ohio. Ohio Wildlife Research Sta., Ohio State Univ., Columbus, Release no. 162, pp. 1–17, mimeog. June 1, 1941.

CHAPMAN, WENDELL, and LUCIE CHAPMAN. Lords of the Rockies. Nat. Geogr., Washington, D. C., vol. 76, no. 1, pp. 87–128, 28 natural color photographs. July, 1939. (Moose, elk, mule deer, pronghorn, bison, mountain sheep, and bear.)

CHEATUM, E. L. Lymphadenitis in New York cottontails. Jour. Wildlife Management, Menasha, vol. 5, no. 3, pp. 304–308, illus. July, 1941.

CLARK, FRANK H. Correlation and body proportions in mature mice of genus *Peromyscus*. Genetics, Princeton, vol. 26, pp. 283–300. May 10, 1941.

CONANT, ROGER. Meet the champions. Fauna, Philadelphia, vol. 3, no. 2, pp. 43–49, illus. June, 1941. (Gorillas.)

CONDON, DAVID. Raccoons in Yellowstone National Park. Yellowstone Nat. Notes, Yellowstone Park, vol. 18, nos. 3–4, pp. 18–19. March-April, 1941.

COWDRY, E. V. (Editor) Problems of ageing. Waverly Press, Inc., Baltimore, 758 pp. 121 figs. January, 1939. (26 contributors.)

CRABTREE, CHARLOTTE. The structure of Bowman's capsule as an index of age and sex variations in normal mice. Anat. Record, Philadelphia, vol. 79, no. 3, pp. 395–413. March 25, 1941.

DALKE, PAUL D. Development of a statewide system of cover-mapping applicable to Missouri wildlife range. Jour. Wildlife Management, Menasha, vol. 5, no. 1, pp. 103–107, pl. 4. January, 1941.

DALQUEST, WALTER W. An isolated race of *Microtus montanus* from eastern Washington. Proc. Biol. Soc. Washington, vol. 54, pp. 145–148. September 30, 1941. (New: *Microtus montanus kincaidi*.)

DEMPSEY, E. W., and G. B. WISLOCKI. The structure of the ovary of the humpback whale (*Megaptera nodosa*). Anat. Record, Philadelphia, vol. 80, no. 2, pp. 243–256, fig. 1, pls. 3. June 25, 1941.

DETWILER, S. R. The eye of the owl monkey (*Nyctipithecus*). Anat. Record, Philadelphia, vol. 80, no. 2, pp. 233–239, figs. 4, pl. 1. June 25, 1941.

DEY, F. L. Changes in ovaries and uteri in guinea pigs with hypothalamic lesions. Amer. Jour. Anat., Philadelphia, vol. 69, no. 1, pp. 61–87, figs. 11. July 15, 1941.

DIAS, EMMANUEL, and FELIX PIFANO C. Estudo experimental de um "Schizotrypanum" do morcego "Hemiderma perspicillatum" da Venezuela. Mem. Inst. Oswaldo Cruz, Rio de Janeiro, vol. 36, fasc. 1, pp. 79–98, pls. 2. March, 1941.

DICE, LEE R. Variation of the deer-mouse (*Peromyscus maniculatus*) on the sand hills of Nebraska and adjacent areas. Contrib. Lab. Vert. Genetics, Univ. Michigan, Ann Arbor, no. 15, 19 pp., 1 map. July, 1941.

DOUTT, J. KENNETH. New *Clethrionomys* from Utah and Pennsylvania. Proc. Biol. Soc. Washington, vol. 54, pp. 161–164. December 8, 1941. (New: *Clethrionomys gapperi uintaensis*, *C. g. paludicola*.)

DUERST, ULRICH. Ein Beitrag zur ältesten Geschichte des Rindes im Bernerland, mit besonderer Berücksichtigung des Simmentaler Rindes. Schweizerische Landwirtschaftliche Monatshefte, Bern, Jahrg. 14, no. 8/9, pp. 203–213, figs. 6. August–September, 1936.

DUGMORE, A. RADCLYFFE. How I photographed Canadian big game. Animal & Zoo Mag., London, vol. 5, no. 12, pp. 4–7, illus. May, 1941.

DUNCAN, A. W. Where gaur and water buffalo meet. Field, London, vol. 177, no. 4611, pp. 388–389, illus. May 10, 1941.

DYMOND, J. R. The study of animal populations. Rod and Gun in Canada, Montreal, vol. 40, pp. 17–18, 26–27. 1939.

ECKELS, RICHARD PRESTON. Greek wolf-lore. A dissertation in Greek presented to the faculty of the graduate school of the University of Pennsylvania in partial fulfillment of the requirements for the degree of Doctor of Philosophy. Philadelphia, 1937, 88 pp.

ENDERS, ROBERT K. Sperm studies as a guide in fur animal breeding practise. Amer. Fur Breeder, Duluth, vol. 14, no. 4, pp. 40–41. October, 1941.

FEDERSPIEL, MATTHEW N. Nutria farming. Amer. Fur Breeder, Duluth, vol. 13, no. 8, pp. 12–13, February 1941; no. 9, p. 26, March 1941; no. 10, pp. 16–17, April 1941; no. 11, pp. 18–20, May 1941. (Male coypu may weigh 26 lbs.)

FENTON, CARROLL LANE. [Review of] Thomas Say, early American naturalist, by Harry B. Weiss and Grace M. Ziegler. Amer. Midland Nat., Notre Dame, vol. 12, no. 10, p. 24. July, 1931.

FERNANDEZ, MIGUEL. Sobre el desarrollo de los órganos en los embriones rudimentarios de la mulita (*"Tatusia hygrida"* Desmarest). Physis (Rev. Soc. Argentina Cien. Nat.), Buenos Aires, vol. 18, pp. 1–13, pl. 1. 1939.

FORBES, E. B., L. F. MARCY, A. LEROY VORIS, and C. E. FRENCH. The digestive capacities of the white-tailed deer. Jour. Wildlife Management, Menasha, vol. 5, no. 1, pp. 108–114, pl. 6. January, 1941.

FOWKE, PHILLIP. Elephant drains. Loris, Ceylon, vol. 2, no. 3, pp. 159–160. December, 1940.

FRYE, JOHN C., and CLAUDE W. HIBBARD. Stratigraphy and paleontology of a new middle and upper Pliocene formation of south-central Kansas. Jour. Geol., Chicago, vol. 49, no. 3, pp. 261–278, figs. 6. April–May, 1941.

FUJIMOTO, HARUYOSHI. A new locality of *Stegodon orientaris shodoensis* Matsumoto? Jour. Geol. Soc. Japan, Tokyo, vol. 43, no. 508, pp. 45–46, 1 pl. January 20, 1936. (In Japanese.)

FULTON, J. F. Encephalization of motor functions during the evolution of the primate nervous system. Ohio Jour. Sci., Columbus, vol. 41, no. 3, pp. 173–182. May, 1941.

GAST, RICHARD. Säugetiere, a. Lösen der Haut vom Tierkörper. b. Die Behandlung von Rohskeletten. c. Kopfhäute—Felldecken—Gehörne—Geweihe. Kleintier und Pelztier, Leipzig, Jahrg. 11, no. 6, pp. 192–204, 12 figs. October, 1935.

GATES, DANIEL W. Babies of our zoo animals. News Bull. Staten Island Zool. Soc., Inc., vol. 8, no. 4, pp. 3–4, illus. July, 1941. (Raccoon, skunk, lemur.)

GOBLE, FRANS CLEON. Tissue changes in white-tailed deer (*Odocoileus virginianus borealis*) accompanying natural infections of lungworms (genera *Protostrongylus* and *Dictyocaulus*). Jour. Wildlife Management, Menasha, vol. 5, no. 2, pp. 141–158, pls. 9–14. April, 1941.

GOKAN, BUNNOSUKE. Historical review of discussions on the fossil elephants found in Japan, in the late Yedo period. Jour. Geol. Soc. Japan, Tokyo, vol. 45, no. 541, pp. 773–776. October 20, 1938.

GOLDMAN, E. A. Three new wolves from North America. Proc. Biol. Soc. Washington, vol. 54, pp. 109–114. September 30, 1941. (New: *Canis lupus alces, C. l. columbianus, C. l. hudsonicus.*)

——— A new western subspecies of golden mouse. Proc. Biol. Soc. Washington, vol. 54, pp. 189–192. December 8, 1941. (New: *Peromyscus nuttalli flammeus.*)

——— A Pleistocene otter from Iowa. Papers on Mammalogy. Zool. Ser., Field Mus. Nat. Hist., vol. 27, pp. 229–231, fig. 45. December 8, 1941. (New: *Lutra iowa.*)

GOODPASTER, WOODROW. Mammals of southwestern Ohio. Jour. Cincinnati Soc. Nat. Hist., vol. 22, no. 3, pp. 41–47. June, 1941.

GRANQUIST, W. A. History of the American platinum on the Buffalo Bill fur farm at Cody, Wyoming. Amer. Fur Breeder, Duluth, vol. 13, no. 12, pp. 10, 12–13, figs. 3. June, 1941.

GRAY, R. W. The bottlenose whale. Naturalist, London, no. 791, pp. 129–132. June, 1941.

GREENE, R. R., M. W. BURRILL, and A. C. IVY. Experimental intersexuality: the effects of combined estrogens and androgens on the embryonic sexual development of the rat. Jour. Exper. Zool., Philadelphia, vol. 87, no. 2, pp. 211–232. July 5, 1941.

GROMIER, ÉMILE. La vie des animaux sauvages de l'Oubangui-Chari. Bibliothèque Géographique, Paris, pp. 239, illus. 1938.

GROSS, LUDWIK. Influence of sex on the evolution of a transplantable mouse sarcoma. Proc. Soc. Exper. Biol. and Med., New York, vol. 47, no. 2, pp. 273–276. June, 1941.

HALL, E. RAYMOND. Revision of the rodent genus *Microdipodops*. Papers on Mammalogy. Zool. Ser., Field Mus. Nat. Hist., vol. 27, pp. 233–277, figs. 47–53. December 8, 1941. (New: *Microdipodops megacephalus nasutus, M. m. ambiguus, M. m. medius, M. m. nexus, M. pallidus ammophilus, M. p. purus.*)

HALL, E. RAYMOND, and C. LYNN HAYWARD. Three new mammals (*Microtus* and *Ochotona*) from Utah. Great Basin Nat., Provo, vol. 2, no. 2, pp. 105–108. June 30, 1941. (New: *Microtus montanus amosus, M. m. nexus, Ochotona princeps utahensis.*)

HAMILTON, W. J., JR. Reproduction of the field mouse *Microtus pennsylvanicus* (Ord). Cornell Univ. Agric. Exper. Station, Ithaca, Mem. 237, pp. 23, figs. 9. January 7, 1941.

——— Notes on some mammals of Lee County, Florida. Amer. Midland Nat., Notre Dame, vol. 25, no. 3, pp. 686–691, fig. 1. May, 1941.

HAMMOND, JOHN. Fertility in mammals and birds. Biol. Reviews Cambridge Philos. Soc., Cambridge, vol. 16, no. 3, pp. 165–190. July, 1941.

HANSON, HERBERT C., and C. T. VORHIES. Need for research on grasslands. Scientific Monthly, Lancaster, vol. 46, pp. 230–241, illus. March, 1938.

HARTMAN, CARL G., and GEORGE W. CORNER. The first maturation division of the macaque ovum. Carnegie Inst. Washington Publ. 538 (Contrib. to Embryology, no. 179), pp. 1–6, pls. 2. 1941.

HATCH, MELVILLE H. The logical basis of the species concept. Amer. Nat., Lancaster, vol. 75, no. 758, pp. 193–212. May–June, 1941.

HAUPT, OSKAR. Rothirsche aus dem Diluvium und Alluvium des Oberrheintales in Hessen. Notizblatt Hessischen Geol. Landesanstalt zu Darmstadt, Folge 5, no. 19, pp. 25–35, pls. 1–2. 1938.

HAWKINS, ARTHUR S. A wildlife history of Faville Grove, Wisconsin. Trans. Wisconsin Acad. Sci., Arts & Letters, Madison, vol. 32, pp. 29–65. 1940.

HAYNE, D. W. Michigan trappers. Michigan State College, Agric. Exper. Station, Special Bull. 307, East Lansing, 34 pp., 6 figs. June, 1941.

HEDGES, R. FRANK. A method for determining extent of rodent dens. Jour. Wildlife Management, Menasha, vol. 5, no. 2, pp. 129–130. April, 1941.

HELLER, FLORIAN. Wühlmausreste aus den altidiluvialen Sanden von Mauer a. d. Elsenz. Jahresb. und Mitteil. Oberrheinischen geol. Vereines, Stuttgart, n. F., vol. 23, Jahrg. 1934, pp. 139–144, 2 figs. March, 1934.

——— Eine Tierfährtenfundstelle im Rotliegenden Oberhessens. Jahresb. und Mitteil. Oberrheinischen geol. Vereines, Stuttgart, n. F., vol. 26, Jahrg. 1937, pp. 76–78, 3 figs. February, 1937.

HENNESSY, D. J. G. Ceylon, records of big game. Loris, Ceylon, vol. 2, no. 2, pp. 137–139. June, 1940.

HEUSER, CHESTER H., and GEORGE L. STREETER. Development of the macaque embryo. Carnegie Inst. Washington Publ. 538 (Contrib. to Embryology, no. 181), pp. 15–55, pls. 33, 5 figs. 1941.

HILL, JOHN ERIC, and T. DONALD CARTER. The mammals of Angola, Africa. Bull. Amer. Mus. Nat. Hist., New York, vol. 78, pp. 1–211, figs. 36. June 25, 1941.

HILL, W. C. OSMAN. [Loris]. Loris, Ceylon, vol. 1, no. 1, pp. 7–9, illus. November, 1936.

——— Notes on Layard's flying squirrel (*Petinomys layardi*). Loris, Ceylon, vol. 2, no. 2, pp. 121–122, illus. June, 1940.

——— Do lemurs comb their fur with their teeth? Loris, Ceylon, vol. 2, no. 3, pp. 179–181, illus. December, 1940.

HILZHEIMER, MAX. Eine kurze Übersicht über die Wildhunde. Kleintier und Pelztier, Leipzig, Jahrg. 11, no. 3, pp. 83–95, 11 figs. May, 1935.

HINTON, M. A. C. What are dugongs? Loris, Ceylon, vol. 1, no. 2, pp. 82–84, illus. June, 1937.

HIRASAKA, KYOSUKE. A pigmy sperm-whale. Zool. Mag. (Japan), Tokyo, vol. 48, no. 2, pp. 72–74, fig. 1. February, 1936.

HOOPER, EMMET T. Mammals of the lava fields and adjoining areas in Valencia County, New Mexico. Misc. Publ. Mus. Zool., Univ. Michigan, Ann Arbor, no. 51, 47 pp., 3 pls., 1 map. June 14, 1941.

——— The type specimen of the water buffalo, *Anoa mindorensis* Steere. Occas. Papers Mus. Zool., Univ. Michigan, Ann Arbor, no. 443, 4 pp. July 18, 1941.

——— Type localities of pocket gophers of the genus *Thomomys*. Misc. Publ. Mus. Zool., Univ. Michigan, Ann Arbor, no. 52, pp. 1–26, map. July 21, 1941.

HURUHATA, KITAO. On the attrition and extrusive growth of the incisors in a Formosan wild rat, *Rattus losea* (Swinhoe). Jour. Soc. Trop. Agric., Formosa, vol. 12, no. 3, pp. 171–182. November, 1940. (In Japanese with English resumé.)

HYDE-PARKER, T. The badger. Naturalist, London, no. 791, pp. 141–145. June, 1941.

IJIRI, SHOJI. On the tooth-germ (or Zahnkeim) of *Desmostylus japonicus* Tokunaga et Iwasoki. Jour. Geol. Soc. Japan, Tokyo, vol. 44, no. 525, p. 532. June 20, 1937. (In Japanese.)

INGHAM, GUY S. Platinum mink. Amer. Fur Breeder, Duluth, vol. 13, no. 12, p. 8, fig. 1. June, 1941.

JACKSON, A. D. Abstracts of bulletins no. 581–595, circulars no. 86–90, and other publications during 1940. Texas Agric. Exper. Sta., Circ. no. 93, 51 pp. July, 1941.

JACKSON, HARTLEY H. T. A new pine mouse, genus *Pitymys*, from Wisconsin. Proc. Biol. Soc. Washington, vol. 54, pp. 201–202. December 8, 1941. (New: *Pitymys pinetorum schmidti*.)

JENSEN, POUL VALENTIN. Lidt om danske Pattedyrs Faert og Faertorganer. Naturens Verden, København, Aargang 25, hefte 6, pp. 241–266, figs. 24. 1941. (Scent glands.)

JURRIAANSE, M. W. "Empty tummies." The Ceylon elephant in Dutch times. Loris, Ceylon, vol. 2, no. 3, pp. 148–154, illus. December, 1940.

KATZ, DAVID T. A key to the mammals of Ohio. Ohio Wildlife Research Sta., Ohio State Univ., Columbus, Release no. 158, pp. 1–34, mimeog. June 1, 1941.

KEIBEL, F. Normentafeln zur Entwicklungsgeschichte der Wirbeltiere. Fünfzehntes (Ergänzungs-) Heft Normentafel zur Entwicklungsgeschichte der Wanderratte (*Rattus norvegicus* Erxleben), Jena, 162 pp., 26 pls. 1937.

KELLOGG, REMINGTON. [Review of] American mammals. W. J. Hamilton, Jr. Illustrated, pp. xii + 434. 1939. Scientific Monthly, Lancaster, vol. 52, no. 6 (no. 309), pp. 566–567. June, 1941.

KESTEVEN, H. LEIGHTON. Some features in the anatomy and later development of the head of *Delphinus delphinus* Linné. Records Australian Mus., Sydney, vol. 21, no. 1, pp. 59–80, figs. 1–29. July 4, 1941.

KLEIN, GEORGE DUNSFORD. The bushy-tailed woodrat. Nature Notes, Peoria, vol. 8, no. 5, pp. 133–135, pl. 1. May, 1941.

KLER, JOSEPH. Hunting customs of the Ordos Mongols. Primitive Man, Washington, D. C., vol. 14, no. 3, pp. 38–48, figs. 3. July, 1941.

KNOUFF, R. A., J. B. BROWN, and B. M. SCHNEIDER. Correlated chemical and histological studies of the adrenal lipids. 1. The effect of extreme muscular activity on the adrenal lipids of the guinea pig. Anat. Record, Philadelphia, vol. 79, no. 1, pp. 17–38. January 25, 1941.

KORMOS, TH. Über die Kleinsäuger der Heppenlochfauna. Jahresb. und Mitteil. Oberrheinischen geol. Vereines, Stuttgart, n. F., vol. 26, Jahrg. 1937, pp. 88–97. February, 1937.

KREFTING, LAURITS W. Methods of increasing deer browse. Jour. Wildlife Management, Menasha, vol. 5, no. 1, pp. 95–102, pl. 3. January, 1941.

KROGMAN, WILTON MARION. The human family tree. Ciba Symposia, Ciba Pharmaceutical Products Inc., Summit, N. J., vol. 3, no. 1, pp. 790–803, figs. 16. April, 1941.

———— Aboriginal physical types in the western hemisphere. Ciba Symposia, Ciba Pharmaceutical Products Inc., Summit, N. J., vol. 3, no. 1, pp. 804–812, figs. 10. April, 1941.

———— The antiquity of man and his culture in the Americas. Ciba Symposia, Ciba Pharmaceutical Products Inc., Summit, N. J., vol. 3, no. 1, pp. 813–824, figs. 12. April, 1941.

KUHN, L. R. Obtaining blood from mice. Science, Lancaster, n. s., vol. 93, no. 2421, p. 504. May 23, 1941.

KÜPFER, MAX. Backenzahnstruktur und Molarentwicklung bei Esel und Pferd. Schweizerische Landwirtschaftliche Monatshefte, Bern, Jahrg. 14, no. 10, pp. 231–248, figs. 1–5, pls. A–B. October, 1936.

LAPPARENT, A. F. DE. Etudes de paléontologie stratigraphique sur les faunes continentales de Provence. Mém. Soc. Géol. France, Paris, n. s., no. 15, fasc. 4, mém., pp. 1–36, figs. 11, pl. 1. 1938.

LAQUER, WERNER. Weitere Untersuchungen über den Uterus masculinus unter dem Einfluss verschiedener Hormone. Acta Brevia Neerlandica Physiol., Pharmacol., Microbiol. E. A., Amsterdam, vol. 6, pp. 147–151. 1936.

LEEKLEY, JAMES R., and ROBERT K. ENDERS. The determination of heat in the marten. Amer. Fur Breeder, Duluth, vol. 13, no. 12, pp. 26–28, figs. 2. June, 1941.

LEON, J. ALBERTO. Algunas consideraciones sobre los camélidos de los Andes. Bol. Mus. Hist. Nat. "Javier Prado", Lima, año 3, no. 11, pp. 95–105, illus. 1939.

LEVINE, CHARLES J., WALTER MANN, HAROLD C. HODGE, I. ARIEL, and O. DUPONT. Distribution of body weight in the organs and tissues of the rabbit. Proc. Soc. Exper. Biol. and Med., New York, vol. 47, no. 2, pp. 318–321. June, 1941.

LEWIS, F. The water rat in Victoria. Victorian Nat., Melbourne, vol. 58, no. 2, pp. 20–21. June, 1941. (Australian water rat.)

LEWIS, WARREN H., and CARL G. HARTMAN. Tubal ova of the rhesus monkey. Carnegie Inst. Washington Publ. 538 (Contrib. to Embryology, no. 180), pp. 7–14, pl. 1. 1941.

LIUTIKOV, K. M. The results of in-breeding in the absence of genetical control and selection of animals. Problems of Animal Husbandry, Moscou, no. 3, pp. 15–44, figs. 2. 1936. (In Russian.)

LONG, W. S. The utilization of Russian thistle by wildlife. Jour. Wildlife Management, Menasha, vol. 5, no. 2, pp. 136–138. April, 1941.

LÖNNBERG, EINAR. Några ord om Nordamerikas sällsynta däggdjur. Fauna och Flora, Uppsala, 1941, no. 4, pp. 163–172. 1941.

LOO, YÜ-TAO. The mammalian endbrain. I. The septum. Contrib. Biol. Lab. Sci. Soc. China, Shanghai, vol. 15, zool. ser., no. 3, pp. 29–68, figs. 41. 1941.

——— The paraphysis in adult mammalian brains. Contrib. Biol. Lab. Sci. Soc. China, Shanghai, vol. 15, zool. ser., no. 4, pp. 71–76, figs. 2. 1941.

LUSHINGTON, A. B. A note on fauna protection in Ceylon. Loris, Ceylon, vol. 1, no. 1, pp. 11–16. November, 1936.

MANUS, M. B. C. Wirkung von männlichen Hormonen bei Mäusen. Acta Brevia Neerlandica Physiol., Pharmacol., Microbiol. E. A., Amsterdam, vol. 6, pp. 101–104. 1936.

MARX, LORE. Replacement of ovocytes in the ovary of normal and hormone-injected young rats. Anat. Record, Philadelphia, vol. 79, no. 1, pp. 115–131, 2 pls. January 25, 1941.

McGREW, PAUL O. Heteromyids from the Miocene and lower Oligocene. Geol. Ser., Field Mus. Nat. Hist., Chicago, vol. 8, no. 9, pp. 55–57, fig. 17. October 31, 1941. (New: *Heliscomys woodi*.)

——— The Aplodontoidea. Geol. Ser., Field Mus. Nat. Hist., Chicago, vol. 9, no. 1, publ. 510, 30 pp., 13 figs. December 5, 1941. (New: *Promylagaulus*, *P. riggsi*.)

MEADE, GRAYSON E. A new erinaceid from the lower Miocene. Geol. Ser., Field Mus. Nat. Hist., Chicago, vol. 8, no. 7, pp. 43–47, figs. 15. September 30, 1941. (New: *Metechinus marslandensis*.)

MELANDER, Yngve. Lappnäbbmusen, ett nytt däggdjur funnet i norra Sverige. Fauna och Flora, Uppsala, häft. 5, pp. 193–202, figs. 4. 1941. (*Sorex*.)

MILLER, RUTH A. The laryngeal sacs of an infant and an adult gorilla. Amer. Jour. Anat., Philadelphia, vol. 69, no. 1, pp. 1–17, figs. 4. July 15, 1941.

MOORE, CARL R. Embryonic differentiation of opossum prostate following castration, and responses of the juvenile gland to hormones. Anat. Record, Philadelphia, vol. 80, no. 3, pp. 315–327, 1 pl. July 25, 1941.

MORRISON, CROSBIE. Does the ghost bat still fly? Victorian Nat., Melbourne, vol. 58, no. 1, pp. 3–5, fig. 1. May, 1941. (*Macroderma gigas.*)

MULLIGAN, R. M. Quantitative studies on the bone marrow of the dog. Anat. Record, Philadelphia, vol. 79, no. 1, pp. 101–108. January 25, 1941.

MUNTIU, N., and GEORGE D. VASILIU. Nouvelles contributions à l'étude des rats de Roumanie. Notationes Biologicae, Bucureţsi, vol. 1, no. 2, pp. 78–83, figs. 5. May 15, 1933.

NAGAO, T. Classification and geological distribution of the Desmostylidae. Jour. Geol. Soc. Japan, Tokyo, vol. 44, no. 525, pp. 533–534. June 20, 1937. (In Japanese.)

NAUNDORFF, ELIS. Über *Crossarchus obscurus* Fr. Cuv. als Hausgenossen. Carnivoren-Studien, vol. 2. Kleintier und Pelztier, Leipzig, Jahrg. 12, no. 8, pp. 97–102. December, 1936.

——— Eingewöhnung und Abrichtung von Kleinsäugern. Carnivoren-Studien, vol. 2. Kleintier und Pelztier, Leipzig, Jahrg. 12, no. 8, pp. 103–106. December, 1936.

NICOLAESCU-BARBU, VIRGINIA, and EMIL PAPPADOPOL. Mamifere quaternare dela Tecuci (Colectia M. Dumitriu-Tecuci). Notationes Biologicae, Bucureşti, vol. 1, no. 3, pp. 109–114, figs. 6. October 15, 1933.

NIKITIN, A. N. Ueber einen Fund von *Cricetulus migratorius* in der Tschuwaschenrepublik. Vseukraïńska Akad. Nauk, Trudy Prirodnicho-tekhnichnii Viddil, Kief, Livr. 1–2, no. 10, pp. 167–168. (1930) 1931. (In Russian, with German summary.)

NYQUIST, WILLIAM. A battle of wits. Yellowstone Nat. Notes, Yellowstone Park, vol. 18, nos. 3–4, pp. 16–17. March–April, 1941.

ORTENBURGER, A. I., and R. D. BIRD. The ecology of the western Oklahoma salt plains. Publ. Univ. Oklahoma Biol. Surv., vol. 5, no. 3, pp. 49–87, figs. 21–49. December 30, 1933.

OSBORN, FAIRFIELD. The opening of the African plains. Bull. New York Zool. Soc., vol. 44, no. 3, pp. 67–73, figs. 6. May–June, 1941.

PARRATT, LLOYD P. Photographing Yosemite birds and small mammals in color. Yosemite Nat. Notes, Yosemite, vol. 20, no. 5, pp. 38–40. May, 1941.

PATTERSON, BRYAN. History of elephant order traced in fossil exhibit. Field Mus. News, Chicago, vol. 12, no. 5, pp. 7–8, fig. 1. May, 1941.

PENN, GEORGE H., JR., and ERNEST C. MARTIN. The occurrence of porocephaliasis in the Louisiana muskrat. Jour. Wildlife Management, Menasha, vol. 5, no. 1, pp. 13–14. January, 1941.

PFIZENMAYER, E. W. Siberian man and mammoth. Blackie and Son Ltd., London and Glasgow, pp. xii + 256, illus. 1939. (Translated from the German by Muriel D. Simpson.)

PHILLIPS, W. W. A. A curious case of abnormal antler growth in a Ceylon spotted deer (*Axis axis ceylonensis*). Loris, Ceylon, vol. 1, no. 4, pp. 211–212, illus. June, 1938.

——— A list of the more important animals, birds, and reptiles of Ceylon, with the Sinhalese and Tamil names of each. Loris, Ceylon, vol. 2, no. 2, pp. 140–144. June, 1940.

PIDOPLITSHKA, I. G. Zum Studium ausgestorbener und Relikten-Nagetiere der Waldsteppe und Polesiens. Vseukraïńska Akad. Nauk, Trudy Prirodnicho-tekhnichnii Viddil, Kief, Livr. 1–2, no. 10, pp. 153–166. (1930) 1931. (In Russian, with German summary.)

——— Quartäres Murmeltier aus dem Löss des Reservats "Tschapli". Vseukraïńska Akad. Nauk, Trudy Prirodnicho-tekhnichnii Viddil, Kief, Lief. 6, pp. 115–118, figs. 4. 1933. (In Russian, with German summary.)

POCOCK, R. I. The races of the ocelot and the margay. Papers on Mammalogy. Zool. Ser., Field Mus. Nat. Hist., vol. 27, pp. 319–369. December 8, 1941. (New: *Leopardus pardalis steinbachi, L. wiedii boliviae, L. w. pardictis, L. w. salvinia.*)

POLDERBOER, EMMETT B., LEE W. KUHN, and GEORGE O. HENDRICKSON. Winter and spring habits of weasels in central Iowa. Jour. Wildlife Management, Menasha, vol. 5, no. 1, pp. 115–119, pl. 7. January, 1941.

POMERAT, GERARD ROLAND. Mitotic activity in the pituitary of the white rat following castration. Amer. Jour. Anat., Philadelphia, vol. 69, no. 1, pp. 89–121, figs. 3, pls. 2. July 15, 1941.

PREBLE, NORMAN A. Raccoon management in central Ohio. Ohio Wildlife Research Sta., Ohio State Univ., Columbus, Release no. 161, pp. 1–9, mimeog. April 1, 1941.

RAMSEY, FRANK. Curtains for antelope! Western Sportsman, Denver, vol. 7, no. 1, pp. 6–9, illus. June, 1941.

RASMUSSEN, D. IRVIN. Biotic communities of Kaibab Plateau, Arizona. Ecological Monographs, Durham, vol. 11, no. 3, pp. 229–275. July, 1941.

RICHTER, CURT P. The internal environment and behavior. Part V. Internal secretions. Amer. Jour. Psychiatry, Baltimore, vol. 97, no. 4, pp. 878–893, figs. 11. January, 1941.

——— Behavior and endocrine regulators of the internal environment. Endocrinology, Los Angeles, vol. 28, no. 2, pp. 193–195. February, 1941.

——— Alcohol as a food. Quart. Jour. Studies on Alcohol, New Haven, vol. 1, no. 4, pp. 650–662, figs. 7. March, 1941.

RICHTER, CURT P., and CLARENCE D. HAWKES. The dependence of the carbohydrate, fat and protein appetite of rats on the various components of the vitamin B complex. Amer. Jour. Physiol., Memphis, vol. 131, no. 3, pp. 639–649, figs. 3. January, 1941.

RICHTER, CURT P., and EDWARD C. H. SCHMIDT, JR. Increased fat and decreased carbohydrate appetite of pancreatectomized rats. Endocrinology, Los Angeles, vol. 28, no. 2, pp. 179–192, figs. 5. February, 1941.

RICHTER, HANS. Die Eigentümlichkeiten des Katzenauges. Carnivoren-Studien, vol. 2. Kleintier und Pelztier, Leipzig, Jahrg. 12, no. 8, pp. 69–76, 2 figs. December, 1936.

RITCHIE, J. W. Tips on marten raising. Amer. Fur Breeder, Duluth, vol. 13, no. 12, pp. 22–23, fig. 1. June, 1941.

——— Tips on marten raising. Amer. Fur Breeder, Duluth, vol. 14, no. 1, pp. 16–17. July, 1941.

RUDALL, K. M. The structure of the hair cuticle. Proc. Leeds Philos. and Literary Soc., Scientific Sec., vol. 4, pt. 1, pp. 13–18, fig. 1, pls. 2. July, 1941.

RUSCONI, CARLOS. Cronología de los terrenos neoterciarios de la Argentina en relación con el hombre. Bol. Acad. Nac. Cienc. Cordoba, vol. 35, entr. 2a–3a, pp. 151–181. 1941.

RYSGAARD, G. N. Bats of Minnesota. Conservation Volunteer, St. Paul, vol. 2, no. 8, pp. 15–18. May, 1941.

SANBORN, COLIN CAMPBELL. Descriptions and records of neotropical bats. Papers on Mammalogy. Zool. Ser., Field Mus. Nat. Hist., Chicago, vol. 27, pp. 371–387. December 8, 1941. (New: *Myotis nigricans nicholsoni*, *Molossops temminckii griseiventer*, *Tadarida similis*.)

SANDERS, EARL. A preliminary report on the study of white-tailed deer in the Edwards Plateau of Texas. Jour. Wildlife Management, Menasha, vol. 5, no. 2, pp. 182–190. April, 1941.

SCHARRER, ERNST. Arteries and veins in the mammalian brain. Anat. Record, Philadelphia, vol. 78, no. 2, pp. 173–196. October 25, 1940.

SCHERWITZ, HAROLD. Texas and Vermont deer hunting compared by San Antonio scribe. Monthly Bull. Texas Game, Fish and Oyster Commission, Austin, vol. 4, no. 3, p. 3. February, 1941.

SCHMID, BASTIAN. Zur Psychologie der Caniden. Wolf—Hund—Fuchs. Carnivoren-Studien, vol. 1. Kleintier und Pelztier, Leipzig, Jahrg. 12, no. 6, pp. 77, 11 pls. October, 1936.

SCHMIDT, IDA G., and FRANKLIN G. HOFFMAN. Proliferation and ovogenesis in the germinal epithelium of the normal mature guinea pig ovary, as shown by the colchicine technique. Amer. Jour. Anat., Philadelphia, vol. 68, no. 2, pp. 263–273, 1 pl. March 15, 1941.

SCHULTZ, ADOLPH H. Fetal growth and development of the rhesus monkey. Carnegie Inst. Washington Publ. 538 (Contrib. to Embryology, no. 155), pp. 71–97, figs. 5, pls. 2. 1941.

SCHUNKE, WILLIAM H., and IRVEN O. BUSS. Trends in the kill of Wisconsin whitetail bucks, 1936–1940. Jour. Wildlife Management, Menasha, vol. 5, no. 3, pp. 333–336, pl. 19. July, 1941.

SCHWANGART, F. Der Manul, *Otocolobus manul* (Pallas), im System der Feliden. Carnivoren-Studien, vol. 2. Kleintier und Pelztier, Leipzig, Jahrg. 12, no. 8, pp. 19–53, 21 figs., pls. 4–16. December, 1936.

SCOTT, J. P. The embryology of the guinea pig. II. The polydactylous monster. A new teras produced by the genes PxPx. Jour. Morphol., Philadelphia, vol. 62, no. 2, pp. 299–321, fig. 1, pls. 3. March 1, 1938.

SCOTT, THOS. G. Methods and computation in fecal analysis with reference to the red fox. Iowa State College Jour. Sci., Ames, vol. 15, no. 3, pp. 279–285. April, 1941.

——— Field identification of Iowa mammals. Nature Notes, Peoria, vol. 8, no. 6, pp. 163–176, figs. 5. June, 1941.

SCOTT, WILLIAM BERRYMAN. The mammalian fauna of the White River Oligocene. Part 5. Perissodactyla. Trans. Amer. Philos. Soc., Philadelphia, n. s., vol. 28, pt. 5, pp. i–xvi, 747–980, 21 figs., 22 pls. June, 1941.

SERA, G. L. Alcuni caratteri scheletrici di importanza ecologica e filetica nei lemuri fossili ed attuali. Studi sulla paleobiologia e sulla filogenesi dei primati. Palaeontographia Italica, Pisa, vol. 38 (n. s., vol. 8), pp. 1–113, figs. 49, pls. 3. 1938.

SHARLAND, M. S. R. Tasmania's rare "tiger". Bull. New York Zool. Soc., vol. 44, no. 3, pp. 84–88, figs. 2. May–June, 1941. (*Thylacinus cynocephalus*.)

SHEBBEARE, E. O. "Flying" snakes, tree shrews and mimicry. Malayan Nature Jour., Kuala Lumpur, vol. 1, no. 4, pp. 157–162, 1 fig., 1 map. July, 1941.

SHELDON, H. H. Hide and squeak!—if you want to get good animal photographs. Nat. Hist., New York, vol. 48, no. 1, pp. 50–51, illus. June, 1941. (Mule deer.)

——— See how they run. Western Sportsman, Denver, vol. 7, no. 1, pp. 24–25, illus. June, 1941.

SHIKAMA, TOKIO. On a new species of fossil deer, *Cervus* (cfr. *Anoglochis*) *praenipponicus* sp. nov., from Japan. Jour. Geol. Soc. Japan, Tokyo, vol. 43, no. 510, pp. 168–176. March 20, 1936. (New: *Cervus* (cfr. *Anoglochis*) *praenipponicus*. In Japanese.)

——— On the genus *Parastegodon*. Jour. Geol. Soc. Japan, Tokyo, vol. 43, no. 514, pp. 557–564. July 20, 1936. (In Japanese, with English resumé.)

——— Short notes on the excavation of the ossiferous fissures and caves in Kuzuu during the years 1931 to 1936. Jour. Geol. Soc. Japan, Tokyo, vol. 44, no. 524, pp. 405–420. May 20, 1937. (In Japanese, with English resumé.)

SIMMONS, KATHERINE, and T. WINGATE TODD. Growth of well children: analysis of stature and weight, 3 months to 13 years. Growth, Menasha, vol. 2, no. 2, 1938, paper 46, pp. 93–134, figs. 25. August, 1938.

SIMPSON, GEORGE GAYLORD. The affinities of the Borhyaenidae. Amer. Mus. Novitates, New York, no. 1118, pp. 1–6. June 5, 1941.

——— Some Carib Indian mammal names. Amer. Mus. Novitates, New York, no. 1119, pp. 1–10. June 6, 1941.

——— The Eogene of Patagonia. Amer. Mus. Novitates, New York, no. 1120, pp. 15. June 9, 1941.

——— The species of Hoplophoneus. Amer. Mus. Novitates, New York, no. 1123, pp. 21. June 11, 1941.

SIMPSON, GEORGE GAYLORD. A giant rodent from the Oligocene of South Dakota. Amer. Mus. Novitates, New York, no. 1149, 16 pp., 4 figs. October 20, 1941. (New: *Manitshini*, *Manitshia*, *M. tanka*.)

——— A new Oligocene insectivore. Amer. Mus. Novitates, New York, no. 1150, 3 pp., 1 fig. October 28, 1941. (New: *Domnina thompsoni*.)

SMITH, SEDGWICK E., C. H. WHITAKER, LEO F. DAVIDS, and PERCY V. NOBLE. The inheritance of three coat color mutations in ranch-raised minks. Jour. Heredity, Washington, D. C., vol. 32, no. 5, pp. 173–176, figs. 2. May, 1941.

SOMANADER, S. V. O. The Ceylon rock squirrel. Loris, Ceylon, vol. 2, no. 2, pp. 118–120, illus. June, 1940.

SOUTHERN, H. N., and J. S. WATSON. Summer food of the red fox (*Vulpes vulpes*) in Great Britain: a preliminary report. Jour. Anim. Ecol., Cambridge, England, vol. 10, no. 1, pp. 1–11. May, 1941.

STEAD, DAVID G. Further notes on the koala. With special reference to some recent discussions. Australian Wild Life, Sydney, vol. 1, no. 5, pp. 45–56. April, 1939.

STEARNS, L. A., and M. W. GOODWIN. Notes on the winter feeding of the muskrat in Delaware. Jour. Wildlife Management, Menasha, vol. 5, no. 1, pp. 1–12. January, 1941.

STEVENS, DELYLE. An air-minded marten. Yellowstone Nat. Notes, Yellowstone Park, vol. 18, nos. 3–4, pp. 19–20. March–April, 1941.

STOTT, KEN, JR. Hyenas and their allies. Zoonooz, San Diego, vol. 13, no. 4, p. 6. April, 1941.

STROMER, ERNST. Der Nachweis fossilführenden, untersten Pliocäns in München nebst Ausführungen über die Abgrenzung der Pliocänstufe. Abhandl. Bayerischen Akad. Wissenschaften, Munich, n. F., no. 42, 20 pp., 1 pl. June 5, 1937.

STRONG, WM. DUNCAN. What is a "pre-Amerindian"? Science, Lancaster, n. s., vol. 91, no. 2373, pp. 594–596. June 21, 1940. (American Indian.)

TAGAMI, MASATOSI. A new locality of *Desmostylus*. Jour. Geol. Soc. Japan, Tokyo, vol. 43, no. 508, pp. 47–48, 2 figs. January 20, 1936. (In Japanese.)

TAKAI, FUYUJI. Mammalian remains from Saihana Shell-mound, Tanabemati, Aomori Prefecture. Jour. Geol. Soc. Japan, Tokyo, vol. 43, no. 517, pp. 805–806. October 20, 1936. (In Japanese.)

——— A tooth of elephant from the sea-bottom near the island of Hakurei, Kôkaidô, Korea. Jour. Geol. Soc. Japan, Tokyo, vol. 44, no. 523, pp. 304–305, 1 pl. April 20, 1937. (In Japanese.)

——— Cenozoic mammalian fauna of the Japanese Empire (A preliminary note). Jour. Geol. Soc. Japan, Tokyo, vol. 45, no. 541, pp. 745–763. October 20, 1938.

TANAKA, RYO. Biostatistische Untersuchung über die fluktuierende Variabilitat einiger Messungen bei *Rattus losea* und ihre biologische Bedeutung. Trans. Nat. Hist. Soc. Formosa, vol. 30, nos. 200–201, pp. 189–201. June, 1940.

TANG, C. C. Contribution to the knowledge of the helminth fauna of Fukien. Pt. 1. Avian, reptilian and mammalian trematodes. Peking Nat. Hist. Bull., Peking, vol. 15, pt. 4, pp. 299–316, pls. 4. June, 1941.

TAPIA, AUGUSTO. Las cavernas de Ojo de Agua y Las Hachas. Historia geológica de la región de La Brava en relación con la existencia del hombre prehistórico. Republica Argentina, Ministerio de Agricultura de la Nacion, Direccion de Minas y Geologia, Buenos Aires, bol. no. 43, pp. 122, illus., maps, pls. 26. 1937. (Mammals, pp. 108–113.)

TATE, G. H. H. Results of the Archbold Expeditions, No. 40. Notes on vespertilionid bats. Bull. Amer. Mus. Nat. Hist., New York, vol. 78, pp. 567–597, figs. 4. December 31, 1941. (New: *Kerivoula muscina*.)

TAVERNER, P. A. James Henry Fleming. 1872–1940. Canadian Field-Nat., Ottawa, vol. 55, no. 5, pp. 63–64, photo. May, 1941.

TOBIEN, HEINZ. Bemerkungen zu einem Säugerrest aus der Juranagelfluh von Biesendorf (Amt Engen). Jahresb. und Mitteil. Oberrheinischen geol. Vereines, Stuttgart, n. F., vol. 24, Jahrg. 1935, pp. 132–136, 2 figs. April, 1935.

TODD, T. WINGATE. The record of metabolism imprinted on the skeleton. Amer. Jour. Orthodontics and Oral Surgery, St. Louis, vol. 24, no. 9, pp. 811–826, figs. 12. September, 1938.

TOKUNAGA, SHIGEYASU, and FUYUJI TAKAI. On a fossil elephant, *Palaeolozodon aomoriensis*, from Shichinohe, Kamikitagun, Aomori Prefecture, Japan. Jour. Geol. Soc. Japan, Tokyo, vol. 43, no. 511, pp. 254–258, pls. 2. April 20, 1936.

——— A new roe-deer, *Capreolus* (*Capreolina*) *mayai*, n. subgen. and n. sp. from the Inland Sea of Japan. Jour. Geol. Soc. Japan, Tokyo, vol. 43, no. 515, pp. 642–646, 2 figs., 1 pl. August 20, 1936. (New: *Capreolina*, *Capreolus* (*Capreolina*) *mayai*.)

——— Odontoma in a fossil elephant from the Inland Sea of Japan. Jour. Geol. Soc. Japan, vol. 44, no. 524, pp. 444–446, 1 pl. May 20, 1937. (In Japanese, with English resumé.)

——— On the fossil elephants from Tochigi Prefecture. Jour. Geol. Soc. Japan, Tokyo, vol. 44, no. 525, pp. 536–537. June 20, 1937. (In Japanese.)

TUTEIN-NOLTHENIUS, A. C. Our deer. Loris, Ceylon, vol. 1, no. 2, pp. 92–96. June, 1937.

——— Our elephants. Loris, Ceylon, vol. 1, no. 3, pp. 133–136, illus. December, 1937.

URITA, TOMOYE. The mammoth teeth from the Aniwa Bay in Saghalien. Jour. Geol. Soc. Japan, Tokyo, vol. 44, no. 524, pp. 376–382, pls. 2. May 20, 1937. (In Japanese, with English resumé.)

VAN DER HORST, C. J. On the size of the litter and the gestation period of *Procavia capensis*. Science, Lancaster, n. s., vol. 93, no. 2418, pp. 430–431. May 2, 1941.

VESEY-FITZGERALD, DESMOND. The Jenut Klebang. Malayan Nature Jour., Kuala Lumpur, vol. 1, no. 4, pp. 135–137. July, 1941. (Elephants.)

WALKER, ERNEST P. Animal behavior. Smithsonian Report for 1940, Publ. 3616, pp. 271–312, 18 pls. 1941.

WALKER, M. V. These little pigs have a way. Natl. Park Serv., Reg. 3 Quarterly, vol. 3, no. 3, pp. 15–18, mimeog. July, 1941. (Javelina.)

WAUGH, FRAN. So I began analyzing deer stomachs. South Dakota Conservation Digest, Pierre, pp. 7–8, fig. 1. June, 1941.

WEIDENREICH, FRANZ. Some problems dealing with ancient man. Amer. Anthropologist, Lancaster, vol. 42, no. 3, pp. 375–383. July–September, 1940.

——— The extremity bones of *Sinanthropus pekinensis*. Palaeontologia Sinica, Peking n. s. D, no. 5 (whole ser. no. 116), pp. 1–150, pls. 1–34. 1941.

WEILER, WILHELM. *Alces latifrons* Johns. aus einer Terrasse mit *Elephas trogontheri primigenius*. Jahresb. und Mitteil. Oberrheinischen geol. Vereines, Stuttgart, n. F., vol. 24, Jahrg. 1935, pp. 137–139, 1 fig. April, 1935.

——— Zwei bemerkenswerte Reste von Säugern aus der paläolithischen Fundstelle Pfeddersheim bei Worms. Notizblatt Hessischen Geol. Landesanstalt zu Darmstadt, Folge 5, no. 17, pp. 74–78, 1 pl. 1936.

WHITE, THEODORE E. Additions to the fauna of the Florida Pliocene. Proc. New England Zool. Club, Cambridge, vol. 18, pp. 67–70, pls. 10–12. September, 9, 1941. (New: *Pliogulo*, *P. dudleyi*, *Hexameryx*, *H. simpsoni*.)

——— Additions to the Miocene fauna of Florida. Proc. New England Zool. Club, Cambridge, vol. 18, pp. 91–98. October 4, 1941. (New: *Mephititaxus*, *M. anticipidens*, *Tomarctus thomasi*, *Floridachoerus*, *F. olseni*, *Syndyoceras australis*, *Machaeromeryx gilchristensis*.)

WHITNEY, C. V. A jaguar for the Museum. Nat. Hist., New York, vol. 48, no. 1, p. 24, illus. June, 1941.

WILIMAN, H. B. Mammoth found in Peorian loess near Belleview, Illinois. Amer. Jour. Sci., New Haven, vol. 239, no. 6, pp. 413–416, figs. 2. June, 1941.

WILLMSHAIDE, JUNGKLAUS. Die Bracken. Zeitschr. für Hundeforschung, n. F., vol. 2. Kleintier und Pelztier, Leipzig, Jahrg. 12, no. 7, 95 pp., 56 figs. November, 1936.

WILSON, H. V. Vacuolation a factor in the division of animal cells. Science, Lancaster, n. s., vol. 88, no. 2289, p. 435. November 11, 1938.

——— The recapitulation theory or biogenetic law in embryology. Amer. Nat., Lancaster, vol. 75, pp. 20–30. January–February, 1941.

WINGE, HERLUF. The interrelationships of the mammalian genera. Vol. 1—Monotremata, Marsupialia, Insectivora, Chiroptera, Edentata. København, pp. xii + 418, 1 pl. 1941. (Translated from Danish by E. Deichmann and G. M. Allen.)

WISLOCKI, GEORGE B., and GEORGE L. STREETER. On the placentation of the macaque (*Macaca mulatta*), from the time of implantation until the formation of the definitive placenta. Carnegie Inst. Washington Publ. 538 (Contrib. to Embryology, no. 160), pp. 1–66, fig. 1, pls. 13. 1941.

YOUNG, STANLEY P. Does the puma (mountain lion) scream? Western Sportsman, Denver, vol. 6, no. 6, pp. 6–9, illus. May, 1941.

——— Wanderlust from the plains. Western Sportsman, Denver, vol. 7, no. 2, pp. 9–12, illus. July, 1941. (Coyote.)

ZAKREWSKA, H. Riesenhirsche (*Cervus giganteus* Blum.) im Tschernigiwer Polessje. Vseukraïnśka Akad. Nauk, Trudy Prirodnicho-tekhnichnii Viddil, Kief, Lief. 9, pp. 107–117, figs. 4. 1935. (In Russian, with German summary.)

ZHIVOTKOV, H. I., K. S. GONCHARENKO, and A. K. KRIVOSHCHEKOV. On the problem of studying ovulation in the mare. Problems of Animal Husbandry, Moscou, no. 3, pp. 71–76, fig. 1. 1936. (In Russian.)

COMMENT AND NEWS

CONSERVATION OF SCHOLARLY JOURNALS

The American Library Association created this last year the Committee on Aid to Libraries in War Areas, headed by John R. Russell, the Librarian of the University of Rochester. The Committee is faced with numerous serious problems and hopes that American scholars and scientists will be of considerable aid in the solution of one of these problems.

One of the most difficult tasks in library reconstruction after the first World War was that of completing foreign institutional sets of American scholarly, scientific, and technical periodicals. The attempt to avoid a duplication of that situation is now the concern of the Committee.

Many sets of journals will be broken by the financial inability of the institutions to renew subscriptions. As far as possible they will be completed from a stock of periodicals being purchased by the Committee. Many more will have been broken through mail difficulties and loss of shipments, while still other sets will have disappeared in the destruction of libraries. The size of the eventual demand is impossible to estimate, but requests received by the Committee already give evidence that it will be enormous.

With an imminent paper shortage attempts are being made to collect old periodicals for pulp. Fearing this possible reduction in the already limited supply of scholarly and scientific journals, the Committee hopes to enlist the cooperation of subscribers to this journal in preventing the sacrifice of this type of material to the pulp demand. It is scarcely necessary to mention the appreciation of foreign institutions and scholars for this activity.

Questions concerning the project or concerning the value of particular periodicals to the project should be directed to Wayne M. Hartwell, Executive Assistant to the Committee on Aid to Libraries in War Areas, Rush Rhees Library, University of Rochester, Rochester, New York.

YOUR COOPERATION SOLICITED

There is a demand for information as to current wildlife research being conducted throughout the United States. In order to supply this the U. S. Fish and Wildlife Service will endeavor to assemble and release annually such information in condensed form. It is therefore suggested that you send before June 1, 1942, to the Fish and Wildlife Service, U. S. Department of the Interior, Washington, D. C., any titles of research problems upon which you may be working, with year of probable completion, and your name and address.

ZOOLOGICAL RECORD

The Zoological Society of London has now made it possible to procure sections of the Zoological Record without purchasing the entire volume. Section XVIII, Mammalia, an index to the important papers on mammals appearing during the year, is now available from the Zoological Society at the price of five shillings.

LETTER TO EDITOR

Dear Sir:

As one of the authors of "A Faunal Investigation of Prince Edward County, Ontario" and the one whose papers, because of subject, were given particular review in the "Journal" (November, 1941), I wish to bring to your attention certain circumstances which constitute a background for these and other papers.

The publication in question is in the nature of a preliminary report, local in scope, and one of a series with which you apparently are not familiar. No previous report has received other than notice in the "Journal" and I question whether this one deserved special attention. However, if it seemed worthy of such, it might have been criticized more for its failure to present that which was intended rather than its failure to conform with the reviewer's ideas as to what should have been done.

None of our Ontario distribution papers are based on ecological studies. Field work has been directed largely toward securing Museum specimens and establishing proof of occurrence. This we regard as more immediately essential in our area than an analysis of ecological associations fundamental to the concept of the "biome" and of "ecotones." To pursue such investigations here and now would seem to be applying a rather fine-toothed comb to a relatively unknown area equal in size to the combined state of Maine, Vermont, New York, Pennsylvania, Ohio, Indiana, Michigan, Wisconsin and Minnesota. A coarser instrument would seem more feasible, if this generation wishes to approach an understanding of distributional problems in our area. It may interest you to know that only a few years ago approximately 90% of the factual information pertaining to Ontario's fauna concerned 10% of the area. This situation is being remedied by this Museum in the face of the knowledge that some workers will regard our program as old-fashioned.

In the brief introductory remarks on the Prince Edward County fauna the author employed the terms of Merriam, and to this you object. What alternative system and set of terms, agreed upon by ecologists and equally comprehensive, would you suggest? We used the Merriam names merely in a descriptive sense and have never believed that names "explained" anything.

So far as our employment of the binomial only is concerned, I quote from the introduction to the paper on Prince Edward County mammals: "No attempt has been made to make racial determinations in reporting on the Prince Edward County collection. Such matters are best left for studies of a broader scope in view of the many problems known to exist." We still feel the same way about it.

Eventually adequate collections from our vast area and adjacent ones will be available for studies on sub-specific questions. In the meantime, it seems best not to keep our year to year findings a secret and bury for all time the miscellaneous field notes in personal notebooks.

So far as the arrangement of the Prince Edward County list of mammals is concerned, we have followed Simpson (1931) to family, except that Soricidae and Talpidae were inadvertently reversed. Our sequence of species within each family follows Miller (1924).—L. L. Snyder, *Royal Ontario Museum of Zoology, Toronto, Ontario.*

OBITUARIES

FRANK B. FOSTER

Notice has been received of the death on November 26, 1940, of Frank B. Foster. Mr. Foster became a member of the Society in 1926. He was interested in mammals primarily from the point of view of their conservation and management. He was closely associated with the Academy of Natural Sciences of Philadelphia, serving as a member of the Executive Committee of the Academy and assisting greatly in the collection of specimens for the Museum.

GLOVER MORRILL ALLEN

It is with deep regret that we report the sudden death on February 14, 1942, of Dr. Glover M. Allen, Curator of Mammals at the Museum of Comparative Zoology, Harvard University, and a charter and life member of the American Society of Mammalogists. A fitting tribute to Dr. Allen will appear in a later issue of this Journal.

CLINTON HART MERRIAM

On March 19, 1942, the Father of American Mammalogy died at his home in Berkeley, California. Dr. C. Hart Merriam was a devoted student of North American mammals; he was the first chief of the U. S. Biological Survey, a charter member and first president of the American Society of Mammalogists, and an outstanding figure in the biological explorations of North America. An appropriate memorial to our departed friend and leader will appear in a later number of the Journal.

VERNON BAILEY

Word was received while this number of the Journal was passing through the final stages of publication of the sudden death of Vernon Bailey at his Washington, D. C., home on April 20. An appropriate memorial to the peer of American field mammalogists will appear in a later issue of this Journal.

EDWARD R. WARREN

Similarly, word has been received of the death of Colorado's leading mammalogist, E. R. Warren, in mid-April.

MARCUS WARD LYON, JR.

It is with deep regret that we must add to this list the name of Dr. Marcus Ward Lyon, Jr., who died May 19, 1942.